# PALYNOSTRATIGRAPHY OF THE OLIGO – MIOCENE DENİZLİ ÇARDAK MOLASSE BASIN

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by
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İZMİR

# Ms. Sc. THESIS EXAMINATION RESULT FORM

We certify that we have read the thesis, entitled **"PALYNOSTRATIGRAPHY OF THE OLIGO – MIOCENE DENİZLİ ÇARDAK MOLASSE BASIN"** completed by MEHMET SERKAN AKKİRAZ under supervision of PROF. DR. FUNDA AKGÜN and that in our opinion it is fully adequate, in scope and in quality, as a thesis for the degree of Master of Science.

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# ABSTRACT


This study deals with palynological investigations from the Oligocene of the Çardak – Tokça basin whose sediments exposed in the North of Acıgöl, between the Çardak and Tokça village, SW Turkey. The Acıgöl group forming the basin fill consists of five major formations which are namely from bottom to top Armutalanı, Çardak, Hayrettin, Tokça and Bozdağ.

Armutalanı formation unconformably overlies sedimentary units of the Lycian Nappes. It is composed of alternations of greenish ophiolitic conglomerates and cross laminated mudstone with coal and sandstone lenses.

Çardak formation is laterally and vertically transitional with underlying Armutalanı and overlying Hayrettin formation. This formation consists, from the base upwards, of planar bedded coarse grained sandstone, bioturbated mudstone, mudstone with conglemerate intercalation and poorly sorted reddish conglomerates.

Hayrettin formation is laterally and vertically transitional with overlying Tokça formation. It includes cross bedded, bioturbated greyish sandstones and fossilliferus limestones which is called Sarıkavak reef member. The formation comprises coal horizons. These coal layers are not economical to mining.

Tokça formation generally consists of mudstones with intercalated coals and sandstones. It contains ecological reef member namely Üçtepeler. Üçtepeler reef

member includes abudant coral colony. The formation comprises economic coal seams. The thickness of coal layers varies between 35 and 120 centimetres.

The uppermost unit of the Acıgöl group is Bozdağ formation. The relation between the Bozdağ and Tokça formations is not clear. It is made up of local cross bedded conglomerate, sandstone and bioturbated mudstone alternation. The Mio- Pliocene and Quaternary sediments overlie the Acıgöl group unconformably.

48 samples and 4 measured sections were taken from the Hayrettin and Tokça formations. A total of 55 genera and 104 species were recorded from the Hayrettin and Tokça formations. Of these, 48 genera and 99 species are of spores and pollen and the others fungal spores, dinoflagellates, and incertae cedis.

A new species, which is named *Tricolpopollenites akgünii* has been established. The presence of *Aglaoeridia cyclops, Boehlensipollis hohli, Slowakipollis hipophäeoides, Mediocolpopollis compactus* ssp. *ellenhaunensis, Dicolpopollis kockeli,* and accompanying *Leiotriletes adriennis, Leiotriletes dorogensis, Verrucatosporites alienus, Verrucatosporites scutulum, Intratriporopollenites instructus, Subtriporopollenites simplex* and *Tricolpopollenites henrici* collectively indicate that the age of these formations is the Lower – Middle Oligocene.

Palynolocigal studies and sedimentological features demonstrate that the Hayrettin formation was deposited near deltaic conditions. The presence of *Nypa* (*Spinozonocolpites* ) pollen indicates brakish water to marine coastal enviroment. Tokça formation was deposited in lakes and flood plains of dense lowland and upland vegetation. The presence of *Sparganiaceaeae – Typhaceae* (*Sparganiaceaepollenites* ) and *Aglaoeridia cyclops* in the Tokça formation are true indicators of fresh water habitat.The palynological data suggest a subtropical climate during the deposition of coal seams embedded in both Hayrettin and Tokça formations.

# ÖZET

Bu çalışma, Çardak - Tokça havzasının (Çardak ve Tokça Köyleri arasında, Acıgöl'ün kuzeyinde yer alan) Oligosen sedimentlerindeki palinolojik araştırmalara değinmektedir. Havzayı oluşturan Acıgöl grubu, tabandan tavana doğru Armutalanı, Çardak, Hayrettin, Tokça ve Bozdağ olmak üzere beş ana formasyon içerir.

Armutalanı formasyonu Likya Napları'nın sedimenter birimlerini uyumsuz olarak üstler. Formasyon kömür ve kumtaşı mercekleri içeren yeşilimsi ofiyolitik çakıltaşları ile çapraz laminalı çamurtaşı ardalanmasından oluşur.

Çardak formasyonu altlayan Armutalanı ve üstleyen Hayrettin formasyonlarıyla yanal ve düşey geçişlidir. Bu formasyon, tabandan tavana düzlemsel katmanlı kaba taneli kumtaşı, biyotürbasyonlu çamurtaşı, çakıltaşı aradüzeyli çamurtaşı ve boylanması kötü kırmızımsı çakıltaşları içerir.

Hayrettin formasyonu üstleyen Tokça formasyonuyla yanal ve düşey geçişlidir. Formasyon çapraz katmanlı ve biyotürbasyonlu grimsi kumtaşları, Sarıkavak resif üyesi olarak adlanan fosilli kireçtaşlarından oluşur ve kömür damarları içerir.

Tokça formasyonu genellikle kömür ve kumtaşı aradüzeyli çamurtaşlarını kapsar. Üçtepeler olarak adlanan ekolojik resif üyesi zengin mercan kolonisi içerir. Formasyon bununla birlikte ekonomik kömür damarları içermektedir.

Acıgöl grubunun en üst birimi Bozdağ formasyonudur. Bozdağ ve Tokça formasyonları arasında ilişki açık değildir. Bozdağ formasyonu yersel çapraz katmanlı çakıltaşı, kumtaşı ve biyotürbasyonlu çamurtaşı ardalanmasından yapılıdır.

Acıgöl grubu Miyo – Pliyosen ve Kuvaterner sedimentleriyle uyumsuz olarak örtülür.

Hayrettin ve Tokça formasyonlarından 48 örnek ve 4 ölçülü kesit alınmıştır. Bu formasyonlardan toplam 55 cins ve 104 tür kaydedilmiştir. Bunların 48 cinsi ve 99 türü spor ve polen, diğerleri ise fungal spor, dinoflagellat ve incertae cedis'tir.

*Tricolpopollenites akgünii* olarak adlanan yeni bir tür saptanmıştır. *Aglaoeridia cyclops, Boehlensipollis hohli, Slowakipollis hipophäeoides, Mediocolpopollis compactus* ssp. *ellenhaunensis, Dicolpopollis kockelii* ve bunlara eşlik eden *Leiotriletes adriennis, Leiotriletes dorogensis, Verrucatosporites alienus, Verrucatosporites scutulum, Intratriporopollenites instructus, Subtriporopollenites simplex* ve *Tricolpopollenites henrici'* nin varlığı birlikte bu formasyonların yaşının Alt – Orta Oligosen olduğunu gösterir.

Palinolojik çalışmalar ve sedimentolojik özellikler, Hayrettin formasyonunun delta yakını koşullarda çökeldiğini belirtir. Bu formasyonda *Nypa (Spinozonocolpites)* poleninin varlığı acısudan denizkıyısına değişen ortama işaret eder. Tokça formasyonu, yoğun dağ önü (düzlük) ve dağ orman topluluklarındaki göller ve taşkın düzlüklerinde çökelmiştir. Tokça formasyonunda *Sparganiaceaeae – Typhaceae (Sparganiaceaepollenites)* ve *Aglaoeridia cyclops'* un varlığı tatlı su habitatının gerçek belirleyicileridir. Palinolojik veriler Hayrettin ve Tokça formasyonlarının her ikisinde de yerleşmiş kömür damarlarının çökelimi süresince subtropikal iklime işaret eder.

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# CHAPTER ONE
# INTRODUCTION

## 1.1 Location of the Study Area

The study area is situated in the North of an area between the Çardak and Dazkırı towns and reaches through the Tokça village (fig. 1. 1). The study area can be reached by İzmir – Denizli highway and Denizli – Tokça and Çardak highways. Small roads and well stabilized gravel roads make transport easy to reach towns and villages spreaded through the region.

The region has high topograpic relief. The Yağlıdoğan hill, Oyuklu hill, Canavar hill, and Toprak hill, are main topographic relief in the study area.

## 1.2 Purpose and Methods

This study presents sphoromorph assemblage from the Çardak - Tokça basin which is located in the North of Çardak. The Oligocene sediments including fine and coarse grained sediments with reefal limestone members unconformably overlie the basement rocks. In this study, measured stratigraphic sections were taken from the Tokça and Hayrettin formations bearing coals and clays. A total of 48 samples were taken from these formations, of which 15 were taken from in 7 coal mines which presents in the Tokça formation. The other samples were taken from stratigraphic sections.

Most of the studies have concerned the general geology and stratigraphy, whereas detailed palynologic studies are rather restricted.

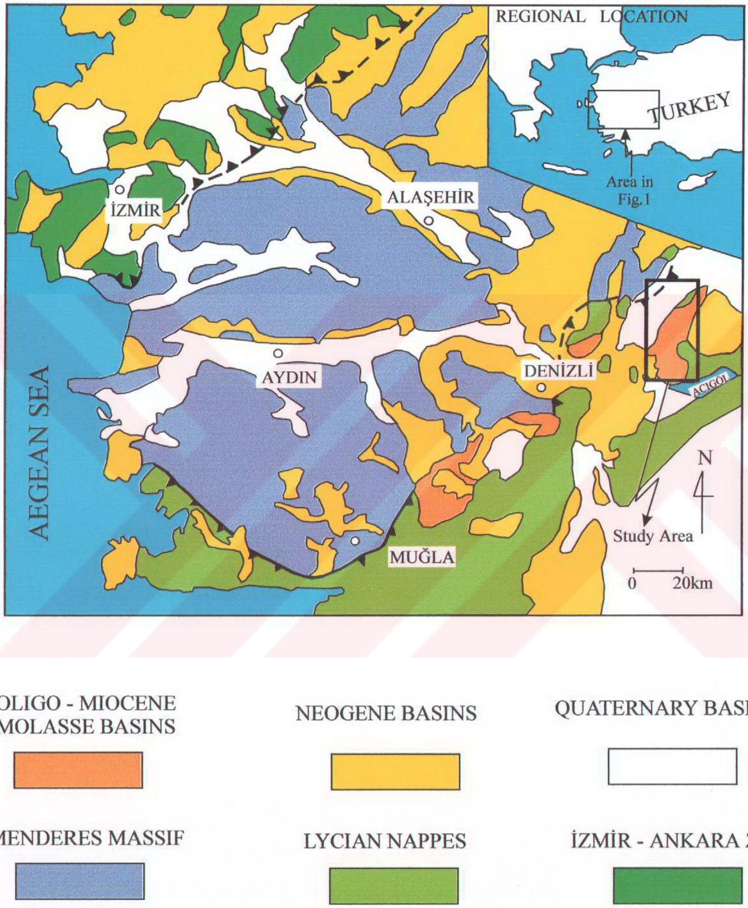


Figure1.1 Location of the Study Area

So far no complete information have been made about study of palynomorphs from the Hayrettin and Tokça formations. Palynological investigation on the Tokça formation was only and firstly made by Benda ( 1971 ). This formation was considered as Tokça assemblage by the author. According to the author the age of the Tokça formation is the Lower – Middle Oligocene.

Significant taxa have been described in these formations. Over one hundred spores, pollen , dinoflagellates , fungal spores and incertae cedis are present in the samples. The spores and pollen assemblage have been useful for precise age determination .

The main purpose of this thesis is to determine the age, paleoclimatology , paleoecology, palynostratigraphy and to demonstrate the most important and interesting pollen species encountered of the Hayrettin and Tokça formations . We have also tried to present comparison of the palynomorhps with previously described of known ages from other parts of Turkey and outside.

### 1.3 Previous studies

The study area was examined by various researchers (Holzer, 1953; Nebert, 1956; Bering, 1968; Lebküchner, 1970; Benda, 1971; Öztürk. 1981; Yalçınkaya et al. 1986, Konak et al. 1987; Göktaş et al. 1989; Şenel et al. 1989; Bilgin et al.1990 and Şenel, 1997). However, the geological researches are continued by the TPAO geologist (Bölükbaşı, 1987).

Bering (1968) studied the Acıgöl area and used the Oligocene Molasse name for the area which is present between the Lütetian limestones and Tertiary sediments. The author separated the Alt Molas, Alt Konglomera, Resif Kalkeri, Üst Molas and Üst Konglomera series. According to the author the age of the Üst Molas serie is the Oligocene.

The Tokça sporomorph association was studied firstly by Benda (1971) and assigned the Lower – Middle Oligocene age on the basis of the palynological studies which their details will be given in Chapter three.

Öztürk (1981) studied the autochthonous units surrounding the Homa – Dinar area. The author separates three units which are, from bottom to top, the Lütetian aged Dinar formation, Lower – Middle Oligocene aged Samsundağ formation and Miocene aged Afşar formation. The author indicates the Samsundağ formation unconformably overlies the Dinar formation and Samsundağ formation is overlain by the Afşar formation. The author also indicates the age of the Samsundağ formation is the Lower – Middle Oligocene based on *Nummulites fichteli* and *Nummulites intermedius*.

Şahbaz & Görmüs (1992) studied sedimantologically the Eocene and Oligocene aged conglomerates which are presents in the North of Çardak (Denizli). The authors separated these units as the Eocene aged conglomerates, Lower Oligocene aged conglomerates and Oligocene aged conglomerates. According to the authors, all of these units include coal.

Göktaş et al. (1989) studied on geology of the North of Acıgöl. The authors indicate that the Oligocene aged units are named the Acıgöl group. According to Göktaş et al. (1989) the Acıgöl group consists of five major formations which are namely from bottom to top Armutalanı, Çardak, Hayrettin, Tokça and Bozdağ . The authors mention that the age of the Hayrettin formation is the Middle and Upper Oligocene based on the bentonic foraminifera. According to the authors the age of the Tokça formation is the Upper Oligocene (Chattian) on the basis of the bentonic foraminifera.

# CHAPTER TWO
# STRATIGRAPHY

## 2.1 Introduction

The study area is located in the North of an area between the Çardak and Dazkırı towns. A few geological studies have been made for different purposes (Benda, 1971; Öztürk, 1981; Göktaş et al., 1989; Şahbaz & Görmüş, 1992; Şenel, 1997). The general features of this area were given by above mentioned the authors (Fig. 2.1). The stratigraphic sequence of the Çardak – Tokça basin may be divided in two rock units as a basement and cover units. General and sedimentological features are given below.

## 2.2 The Basement Rocks

These are characterized by the Lycian Nappes. The Lycian Nappes consist of quartzites, phyllites, metasandstone, metavolcanits, metasiltstone, dolomite, dolomitic limestone, recristalize limestone, conglomerate, sandstone and mudstone alternation and reefal limestone. The age of the Lycian Nappes were reported by Özkaya, 1990 and Şenel, 1991. Özkaya (1990) mentioned that the volcanic rocks of Eocene age were deposited in the Lycian belt. Şenel (1991) studied the Faralya formation that overlies the Lycian Nappes. Faralya formation is characterized *Globorotalia* cf. *pusilla* BOLLI, *Globorotalia* cf. *triloculinoide* PLUMMER, *Globorotalia* cf. *aequa* CUSH. – RENZ., *Globorotalia* cf. *angulata* (WHITE), *Globorotalia* cf. *nex* MARTIN, *Globorotalia* sp.,

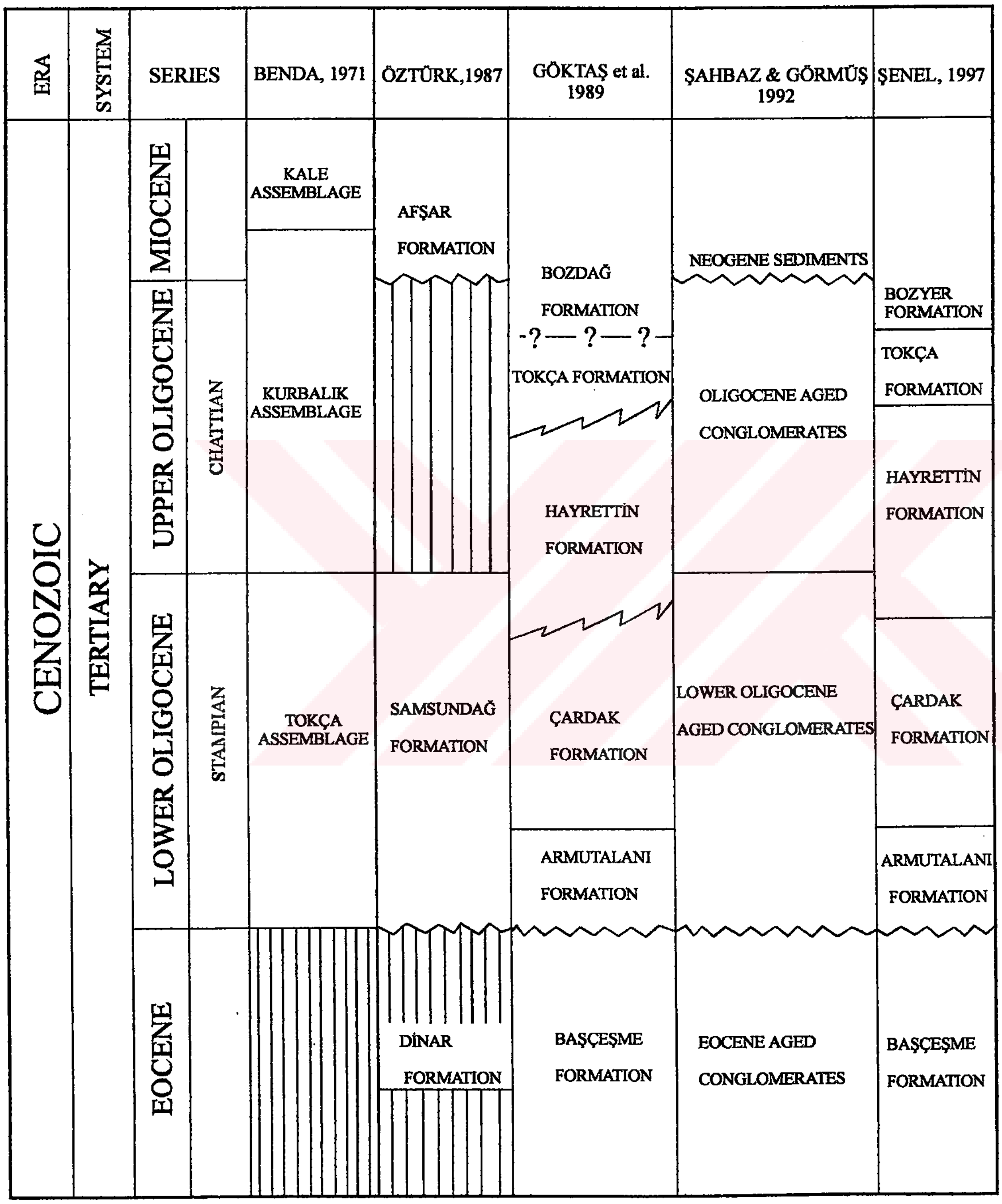


Figure 2.1.Correlation Chart of Denizli - Çardak Basin

*Globigerina* sp., *Anomalina* sp., *Discocyclina* sp., *Hastigerina* sp., *Quinqueloculina* sp., Textulariidae, Rotaliidae, Bryozoa, *Sphaerogypsina globus* REUSS, *Discocyclina* sp., *Nummulites* sp., *Alveolina* sp., *Lochartia* sp., *Europartia* sp., *Asterigerina* sp., *Operculina* sp., *Cuvillerina* sp. and *Lithothamnium* sp. According to the author the age of the Faralya formation is from the Paleocene to Lutetian. the Lycian Nappes locates in the northwest of the Bozkurt village (Fig. 2.3).

## 2.3 Cover Units

These units are characterized with the Acıgöl Group, Mio. – Plio. and Quaternary sediments. The Mio. – Plio. and Quarternery sediments unconformably overlie the Acıgöl Group the. Acıgöl group was named first by Göktaş et al. 1989.

### 2.3.1 Acıgöl Group

The Acıgöl group lies over the Lycian Nappes as an unconformity (Göktaş et al., 1989). It consist of five major formations which are namely from bottom to top Armutalanı, Çardak, Hayrettin, Tokça and Bozdağ (Fig. 2.2). The name of these formations was indicated first by Göktaş et al. (1989).

#### 2.3.1.1 Armutalanı Formation

##### 2.3.1.1.1 Description

The Armutalanı formation was named by Göktaş et al. (1989). It consists of conglomerate – mudstone alternation with sandstone intercalation. This formation is observed around the Armutalanı village and the North of the Dutluca village (Figs. 2. 3).

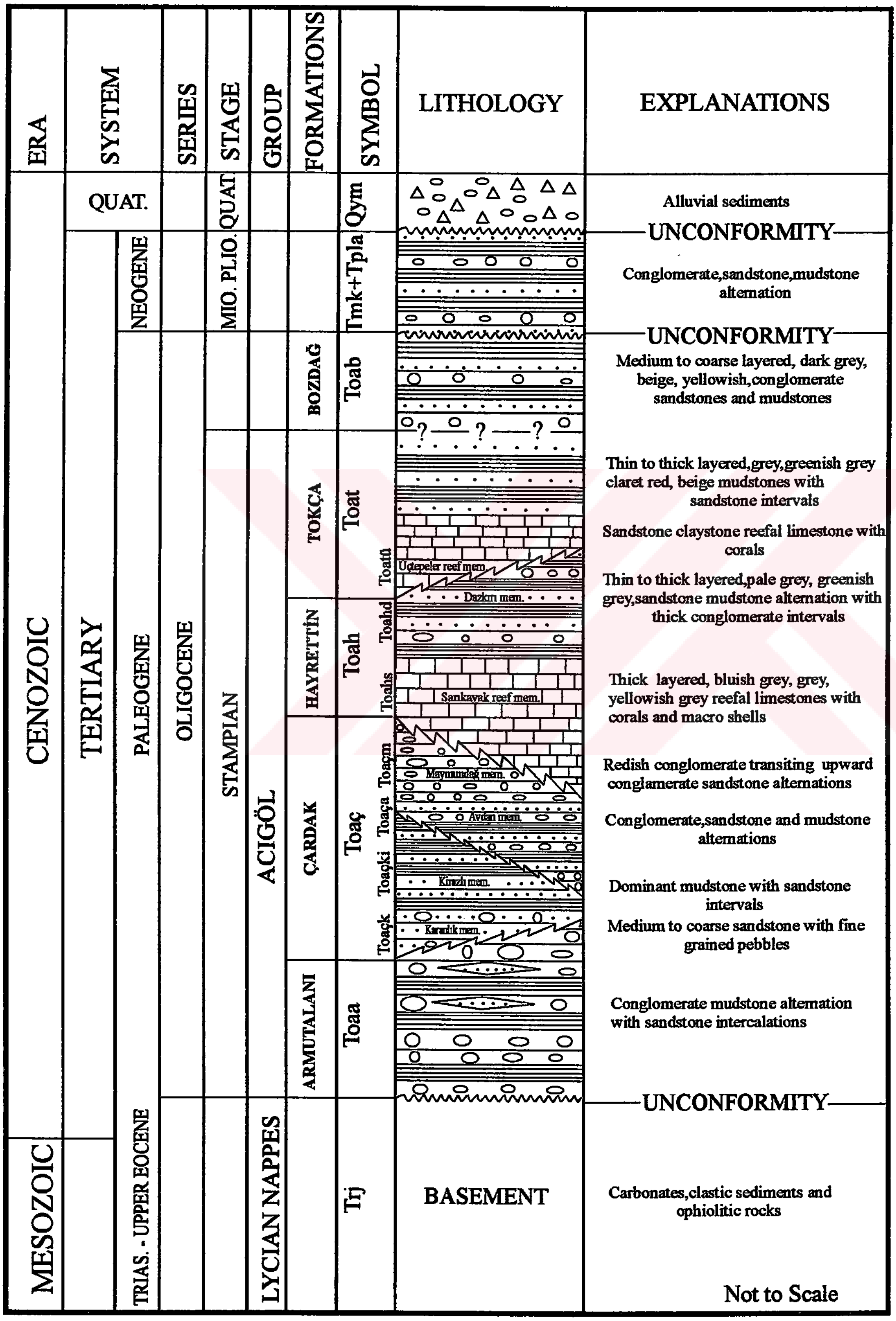


Figure 2.2 Generalized Columnar Section of the Study Area

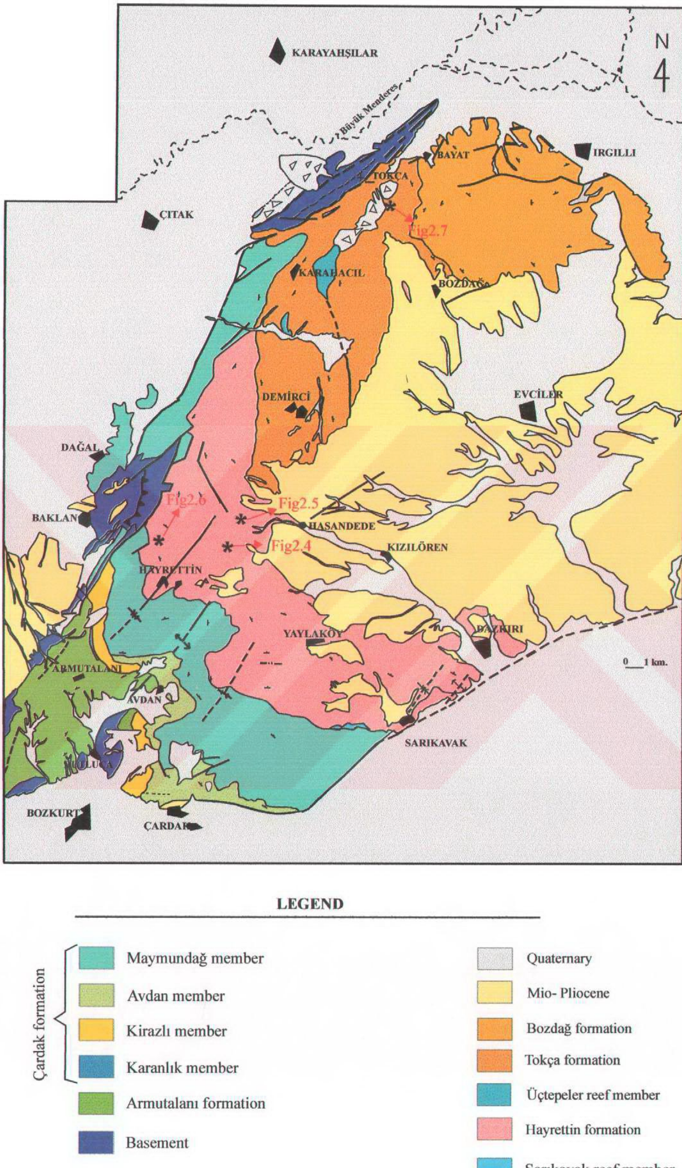


Figure 2.3 The Geological Map of the Çardak - Tokça Basin

#### 2.3.1.1.2 Lithology

The formation comprises conglomerate and mudstone alternation with sandstone lenses. The conglomerates consist of ophiolitic pebbles, which are greenish grey. Their thicknesses may be changed 10 to 30 metres. The conglomerates are poorly sorted and matrix supported. Grain size of the conglomerates changes millimetres to 10 centimetres. The sandstone lenses present in the conglomerates are laterally and vertically transitional with the conglomerates. They include lignite intercalations having millimetric thicknesses. Grey or greyish mudstones are thick and clear bedded.

#### 2.3.1.1.3 Contact

The Armutalanı formation unconformably overlies the Lycian Nappes (Fig.2.2). According to Göktaş et al., (1989) the Kirazlı member that at the base of the Çardak formation conformably overlies the Armutalanı formation. Sözbilir et al. (2000) mention that the Armutalanı formation is laterally and vertically transitional with overlying Çardak formation.

#### 2.3.1.1.4 Age and Fossil Content

There is no palynological diagnosis except one dinoflagellate *Cordosphaeridium inodes* (KLUMP, 1953) MORG. 1966 taken from this coal lenses.

Göktaş et al. (1989) mention that the age of the Armutalanı formation is the Lower Oligocene based on pelagic foraminifera found in mudstone which are *Globigerina* cf. *ampliapertura* (BOLLI), *Globigerina* cf. *sellii* (BORSETTI) and the assemblage of the nannoplankton that *Sphenolithus distensus* (MARTINI), *Sphenolithus predistensus* (MULLER), *Zygrhablithus bijugatus* (DEFLANDRE) and *Pontosphaora multipora* (KAMPNER).

#### 2.3.1.2 Çardak Formation

Göktaş et al. (1989) named first the Çardak formation. The formation crops out in a wide area surrounding north of the Çardak village (Fig. 2.3). It generally consists of conglomerates. It is composed of four members which are namely from bottom to top Karanlık, Kirazlı, Avdan and Maymundağ.

##### 2.3.1.2.1 Karanlık member

###### 2.3.1.2.1.1 Description

This member was named first by Göktaş et al. (1989). It is located at the base of the Çardak formation. It crops out in a restricted area between the Çardak and Armutalanı formations.

###### 2.3.1.2.1.2 Lithology

It consists of medium to coarse grained, yellow, yellowish brown sandstone with fine grained pebbles. The thickness changes between 1 and 10 metres. Sandstones generally have planar bedding. The lower part of the sandstones have a cross bedding. Fine grained pebbles were spreaded within the sandstones.

###### 2.3.1.2.1.3 Contact

The Kirazlı member conformably overlies the Karanlık member (Göktaş et al., 1989). The Kirazlı member has different lithologic characters.

#### 2.3.1.2.1.4 Age and Fossil Content

According to Göktaş et al. (1989) there is no paleontological diagnosis except local shells in Karanlık member. The authors accept the Oligocene age for this member.

### 2.3.1.2.2 Kirazlı member

#### 2.3.1.2.2.1 Description

First Göktaş et al. (1989) named the Kirazlı member and it consists of mudstone with sandstone intervals.The member is located in the northwest of the Çardak village (Figs. 2.3).

#### 2.3.1.2.2.2 Lithology

The Kirazlı member consists of thin and thick bedded, greenish grey, yellowish grey, sandstone and mudstone. It includes small amount of conglomerates. Sometimes the sandstones are poorly sorted and have ripple marks. The dominant rock type is mudstone with sandstone intervals.

#### 2.3.1.2.2.3 Contact

According to Göktaş et al. (1989) and Şenel (1997) the Kirazlı member is laterally and vertically transitional with overlying Avdan member.

#### 2.3.1.2.2.4 Age and Fossil Content

According to Göktaş et al. (1989) the nannoplankton association *Sphenolithus predistensus* BRAMLETTE & WILCOXON, *Sphenolithus distensus* MARTINI, *Sphenolithus moriformis* BRONNIMAN & STRADER, *Zygrhablithus bijugatus*

DEFLANDRE, *Reticulofenestra bisecta* HAY, MOHLER & WADE, *Reticulofenestra reticulata* BRAMLETTE & WILCOXON, *Cyclicargolithus abisectus* MÜLLER, *Cyclicargolithus floridanus* ROTH & HAY, *Helicopontosphaera compacta* BRAMLETTE & WILCOXON, *Helicopontosphaera seminulum* BRAMLETTE & SULLIVAN, *Helicopontosphaera euphratis* HAQ, *Helicopontosphaera perc-nielseniae* HAQ, *Helicopontosphaera intermedia* MARTINI, *Pontosphaera multipora* KAMPTNER, *Pontosphaera plana* BRAMLETTE & SULLIVAN, *Braarudosphaera bigelowi* DEFLANDRE, *Rhabdosphaera perlonga* DEFLANDRE, *Lanternithus minitus* STRADNER, *Coccolithus eopelagicus* BRAMLETTE & SULLIVAN, and the bentonic microfauna association *Nummulites intermedius* d' ARCHIRAC, *Nummulites vascus* JOLY & LEYMERIE, *Halkyardia maxima* CIMERMAN indicate the age of the Lower – Middle Oligocene

**2.3.1.2.3 Avdan member**

**2.3.1.2.3.1 Description**

The Avdan member was named first by Göktaş et al. (1989). The member consists of mudstone sandstone alternation with conglomerate intercalations. It can be observed well in the Aşağıalan region of the North of the Avdan village.

**2.3.1.2.3.2 Lithology**

The member comprises conglomerate, sandstone and mudstone alternation. Conglomerates are greenish grey, bluish grey, poorly sorted and grain supported. Sandstones are bluish pale and dark grey, moderate sorted and include pebble grains.

#### 2.3.1.2.3.3 Contact

Göktaş et al. (1989) and Şenel (1997) mention that the Maymundağ member is conformably overlain by the Avdan member and the Maymundağ member has different litology.

#### 2.3.1.2.3.4 Age and Fossil Content

Göktaş et al. (1989) indicate that bentonic microfauna of the Avdan member is the same with in the Kirazlı member, so the authors mention that the age of the member is Stampian (Lower – Middle Oligocene).

#### 2.3.1.2.4 Maymundağ member

#### 2.3.1.2.4.1 Description

The name was indicated by Göktaş et al. (1989). The member was observed around the northeast Çardak town and it gets thinner to northwest (Fig. 2.3). The Maymundağ member comprises reddish conglomerates transiting upward conglomerate, sandstone alternation.

#### 2.3.1.2.4.2 Lithology

The Maymundağ member is composed of greenish grey, yellowish brown and reddish conglomerates. The member is very poorly sorted. They are locally cross bedded. Conglomerates comprise sandstone intervals and transits to the conglomerate, sandstone alternation. At the lower part of the sequence, lenticular sandstones in conglomerates transit sandstone intercalations upwards. Sandstones are generally yellowish grey ,bluish grey and thick bedded.

#### 2.3.1.2.4.3 Contact

According to Göktaş et al. (1989) and Sözbilir et al. (2000) the Maymundağ member laterally and vertically transitional with overlying the Hayrettin formation. Maymundağ member located at the top of the Çardak formation.

#### 2.3.1.2.4.4 Age and Fossil Content

According to Göktaş et al. (1989) the age of the Maymundağ member, which includes *Nummulites intermedius* (d'ARCHIACH) is the Stampian (Lower – Middle Oligocene).

### 2.3.1.3 Hayrettin Formation

This formation was named by Göktaş et al. (1989). The formation crops out in a wide area around the Hayrettin village (Fig. 2.3). It lies from northwest to southeast. The Hayrettin formation generally comprises sandstones with mudstone and conglomerates intercalations. Sandstones are thin to thick bedded, pale brown, beige, grey, and greenish, local laminated, well bioturbated and sometimes cross bedded. Coal horizons are present within the sandstones. In this study, three measured section were taken from the Hayrettin formation (Figs.2.4, 2.5, 2.6). The formation is composed of two major members which are namely from bottom to top Sarıkavak reef and Dazkırı.

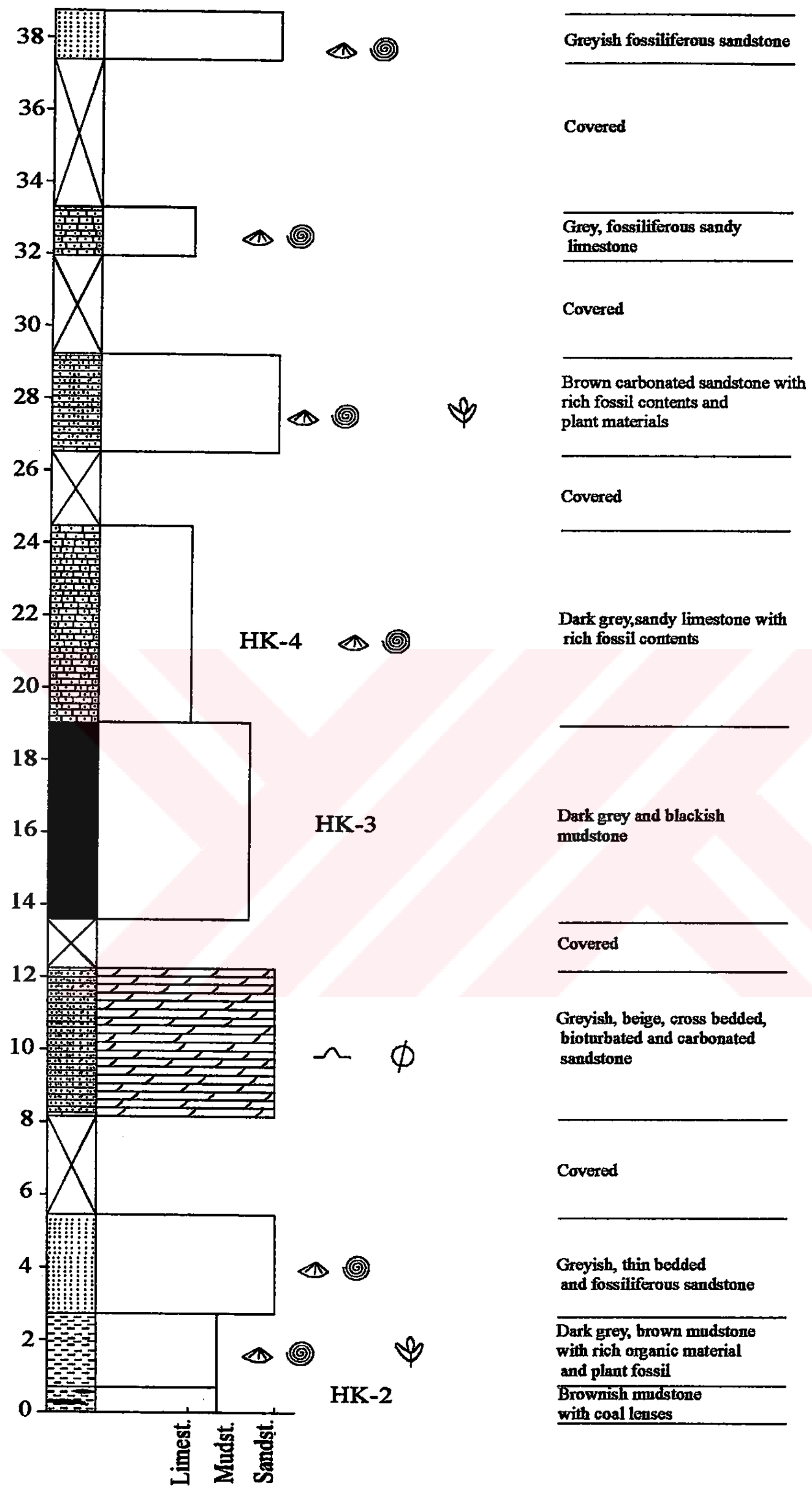


Figure 2.4 Measured Stratigraphic Section - 1of the Northeast Hayrettin Formation. ( See the figure 2.3 for the location of the section ). (39,925;04,350).

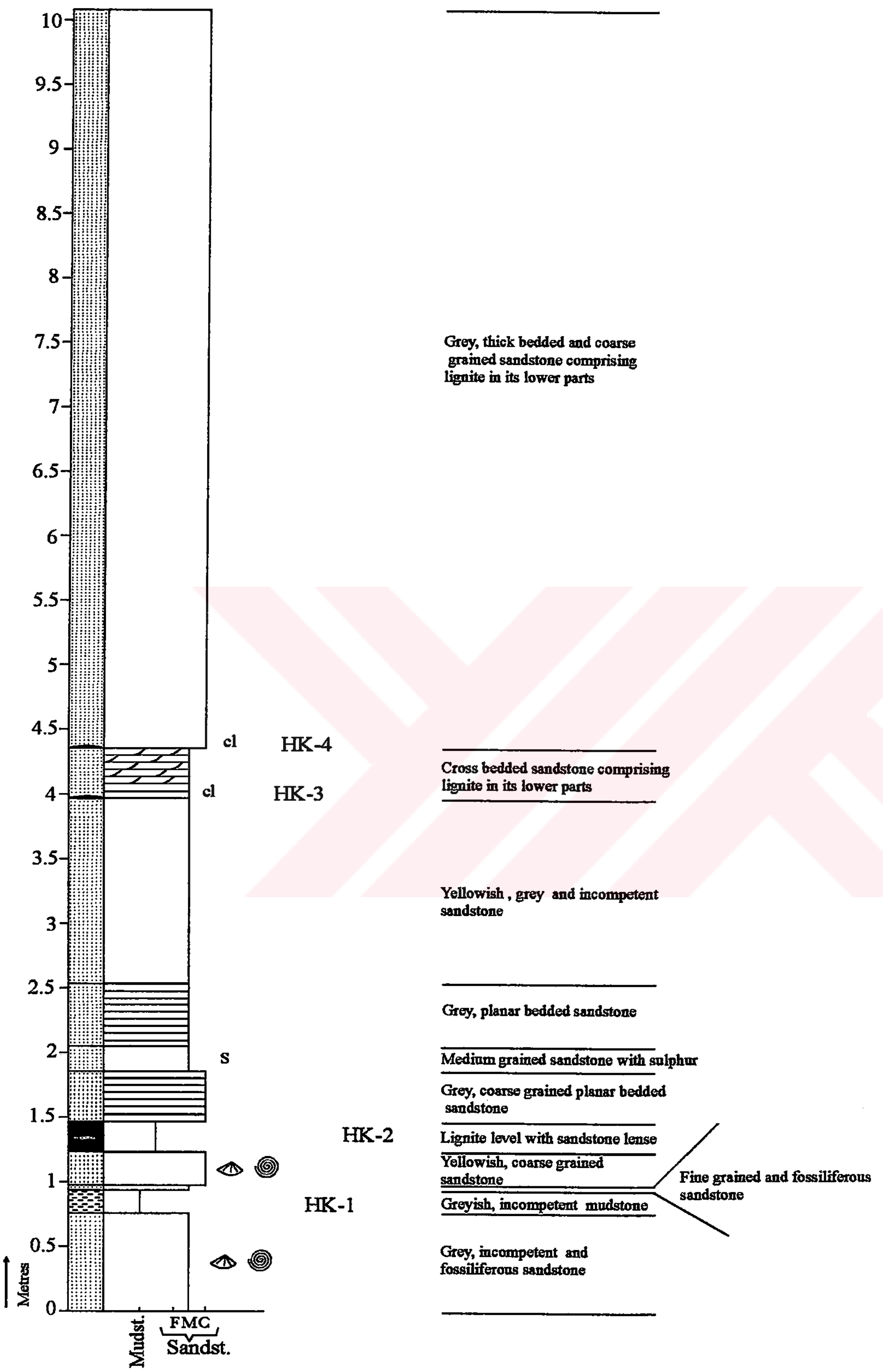


Figure 2.5 Measured Stratigraphic Section - 2 of the Northeast Hayrettin Formation ( See the figure 2.3 for the location of the section). (04,575;34,600).

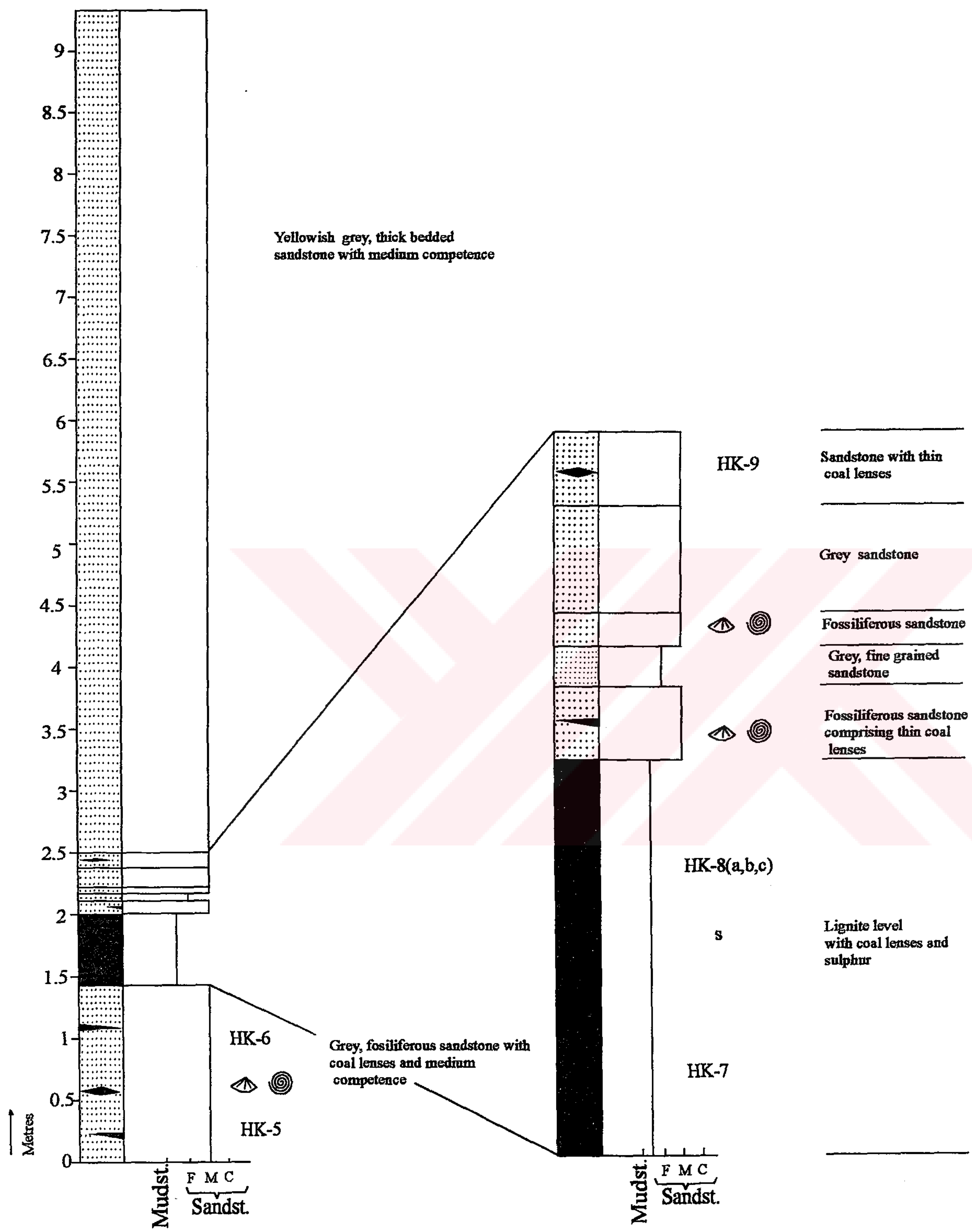


Figure 2.6 Measured Stratigraphic Section - 3 of the Nortwest Hayrettin Formation (See the figure 2.3 for the location of the section). (04, 737;33,212).

#### 2.3.1.3.1 Sarıkavak reef member

##### 2.3.1.3.1.1 Description

The member was named first by Göktaş et al. (1989). The member is present at the lower part of the Hayrettin formation. It comprises reefal limestone, which includes rich coral colony.

##### 2.3.1.3.1.2 Lithology

The Sarıkavak reef member is consisted of bluish grey, yellowish grey reefal limestone. There is no clear bedding. It is moderately 5 meters in thicknesses. It continues laterally about 6 kilometers. The member is rich in coral colony and macro shells. The member transits mudstone or claystone to the upward.

##### 2.3.1.3.1.3 Contact

As mentioned below the Sarıkavak reef member is laterally and vertically transitional with underlying Çardak formation. Göktaş et al. (1989) mention the Dazkırı member conformably overlies the Sarıkavak reef member.

##### 2.3.1.3.1.4 Age and Fossil Content

According to Göktaş et al. (1989) the coral colony *Porites* cf. *oligocenica* CHEVALIER, *Plocophyllia calcyculata* CATULLA, *Reussiphyllia platygyra* REUSS, *Meandrina ataciana* MICHELIN, *Astrocoenia laminosa* d' ACALARDI, *Astrocoenia septemdigitata* CATULLO, *Astrocoenia lobata- rotundata* MICHELIN, *Phyllocoenia irradiano* EDW. & HAIME and the mollusck association *Tympanotonos* (*Eotympanotonos*) *cordieri*, Tympanotonos (*Tympanotonos*) *trochleare diaboli*, *Diastoma* cf. *costellatum elongatum*, *Cyrena valdensis* indicate the age of the Oligocene.

#### 2.3.1.3.2 Dazkırı member

##### 2.3.1.3.2.1 Description

The name was given first by Göktaş et al. (1989). The member is observed in the northeast of the Hayrettin formation (Fig. 2.3). The Dazkırı member generally consists of very thin and thin sandstone alternation with conglomerate intercalations.

##### 2.3.1.3.2.2 Lithology

The member includes thin to thick layered, pale grey and greenish grey sandstone and mudstone alternation with thick bedded conglomerate intervals. Sandstones are well laminated, cross bedded and bioturbated. It wedges into the Hayrettin formation.

##### 2.3.1.3.2.3 Contact

The Dazkırı member is laterally and vertically transitional with overlying Tokça formation (Sözbilir et al., 2000).

##### 2.3.1.3.2.4 Age and Fossil Content

Göktaş et al. (1989) mention that the age of the Hayrettin formation is the Lower – Middle Oligocene based on fossil contents *Lepidocyclina* cf. *dilata* MICHELOTTI, *Lepidocyclina* cf. *tourneri* (LEMOINE & DOUVILLE), *Nummulites intermedius* (D' ARCHIACH), *Nummulites* cf. *vascus, Diastroma costellatum elangatum, Septifer eurydices vapina, Cyrena valdensis, Cyrena sirena sirena,Ostrea*(*Cubitostrea*) *plicata plicata, Ostrea*(*Cubitostrea*) *flabellum* and *Conus*(*Leptaconus*) *diversiformis*. The authors accept the age of the Dazkırı member as an Upper Oligocene (Chattian). The palynological results were discussed in palynology chapter on account of age.

#### 2.3.1.4 Tokça Formation

The formation was named first by Göktaş et al. (1989). The Tokça formation crops out in a wide area between the Tokça and Demirci villages (fig. 2.3). It generally consists of mudstone with sandstone and local lignites. Formation includes economic coal horizons. Seven coal mines are still operated. Reefal limestone, which is named Üçtepeler reef, is present at the base of the formation.

##### 2.3.1.4.1 Üçtepeler reef member

###### 2.3.1.4.1.1 Description

This member is present at the base of the Tokça formation. It is observed best in the Karahacılı village (fig. 2.3). The Üçtepeler reef member name, which was indicated by Göktaş et al. (1989), was used in this study.

###### 2.3.1.4.1.2 Lithology

Göktaş et al. (1989) examined the member as the upper part and lower part of the Üçtepeler reef member. The lower part of the Üçtepeler reef member consist of finning upwards sandstones. At the base of the dominant sandstones sequence comprising coarse grained sandstones with conglomerate intervals transit upwards very fine grained sandstones comprising mudstone and coarse grained sandstone intervals. Sandstones are generally yellowish grey, grey and pale grey, cross bedded and clear bedded. Non economic thin bedded coal horizons are present in the mudstones. Mudstones are generally greenish or bluish grey, yellow, and red and incompetent. A measured section was taken from this part (Fig. 2.7). The upper part of the Üçtepeler reef member generally consist of mudstones with economic coal horizons. The most important lithological difference due to depositional sequence under the Üçtepeler reef member is

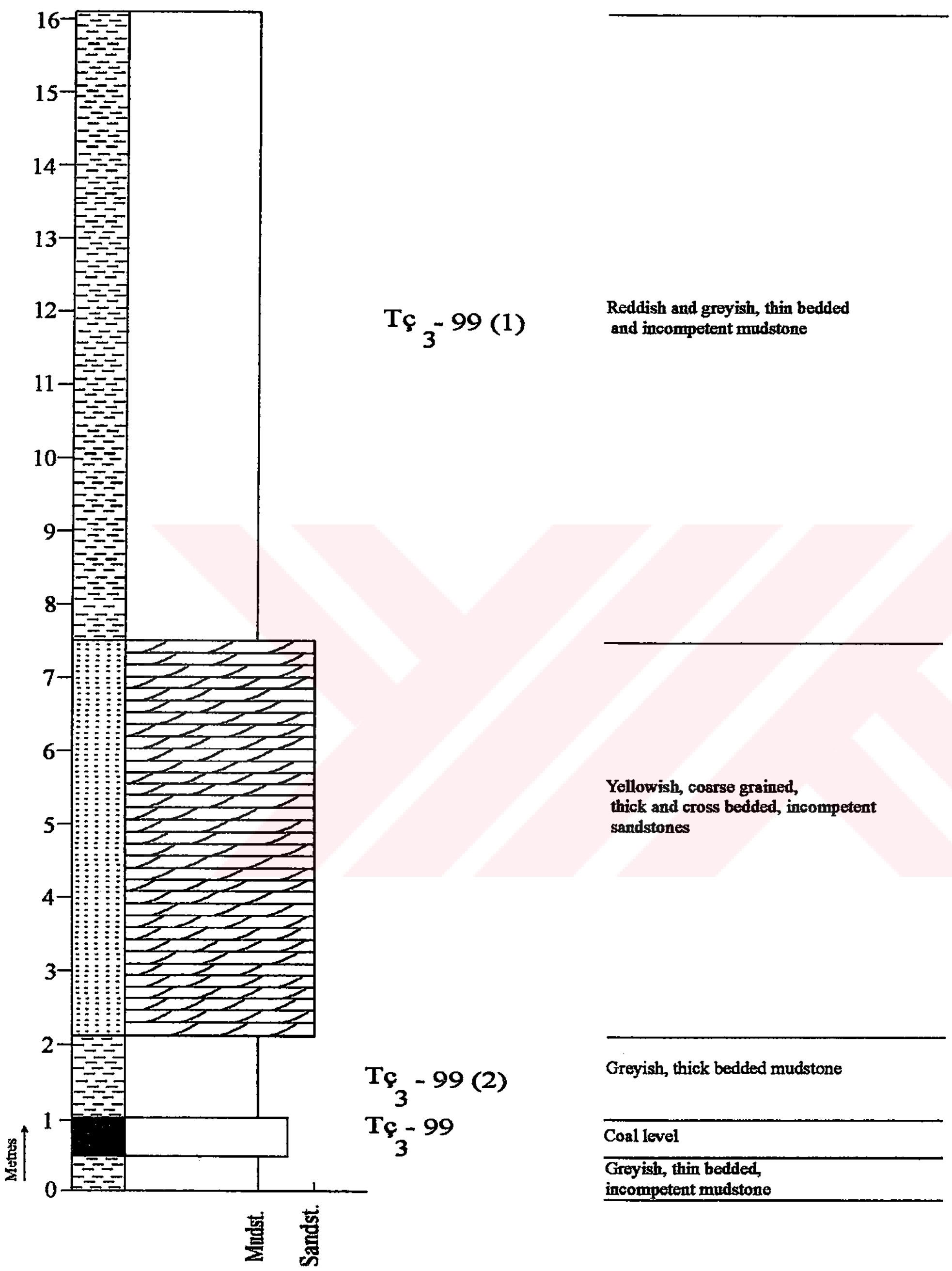


Figure 2.7 Measured Stratigraphic Section from the Southeast of the Tokça Formation. (See the figure 2.3 for the location of the section).( 25, 725;45,187).

a lack of conglomerates in any level. Mudstones are generally pale grey, locally pale green and red and sometimes planar laminated.

#### 2.3.1.4.1.3 Contact

The relation between the Tokça and Bozdağ formation is not clear enough. But Şenel (1997) mentions its probable conformity with Tokça.

#### 2.3.1.4.1.4 Age and Fossil Content

Göktaş et al. (1989) indicate that the age of the Üçtepeler reef member is the Upper Oligocene (Chattian). Göktaş et al. (1989) mention that although the coral association indicates the Lower – Middle Oligocene (Stampian) age, they considered the age of Üçtepeler reef member as an Upper Oligocene (Chattian) due to the bentonic foramifer contents *Lepidocyclina* cf. *dilata* MICHELOTTI and *Lepidocyclina* sp.

Göktaş et al. (1989) accept the age of the Tokça formation as an Upper Oligocene (Chattian) due to palynological results. But there is no palynolocigal assemblage in their publication. Our palynological assemblage was discussed in palynology chapter.

### 2.3.1.5 Bozdağ Formation

#### 2.3.1.5.1 Description

Bozdağ formation was named by Göktaş et al. (1989). It crops out in the East of the Tokça village and South of the Bayat village (fig.2.3). It is present at the top of the Acıgöl group. It consists of conglomerate, sandstone and mudstone alternation.

#### 2.3.1.5.2 Lithology

Bozdağ formation is composed of medium to thick layered ,local cross bedded, dark grey, beige and greenish grey conglomerate, sandstone and mudstone alternation. The conglomerates include sandstone intervals and fine grained pebbles. Sandstones are generally yellowish and thick bedded. Mudstones are generally yellowish, reddish and horizontal bedded. Limestone lenses are present at the base of the formation.

#### 2.3.1.5.3 Contact

The formation is unconformably covered by the Mio – Plio – Quaternary sediments (Göktaş et al., 1989; Şenel, 1997).

#### 2.3.1.5.4 Age and Fossil Content

The age of the formation is the Upper Oligocene (Chattian) – Lower Miocene (Aquitanian) besed on the statıgraphic position ( Göktaş et al., 1989 and Şenel, 1997).

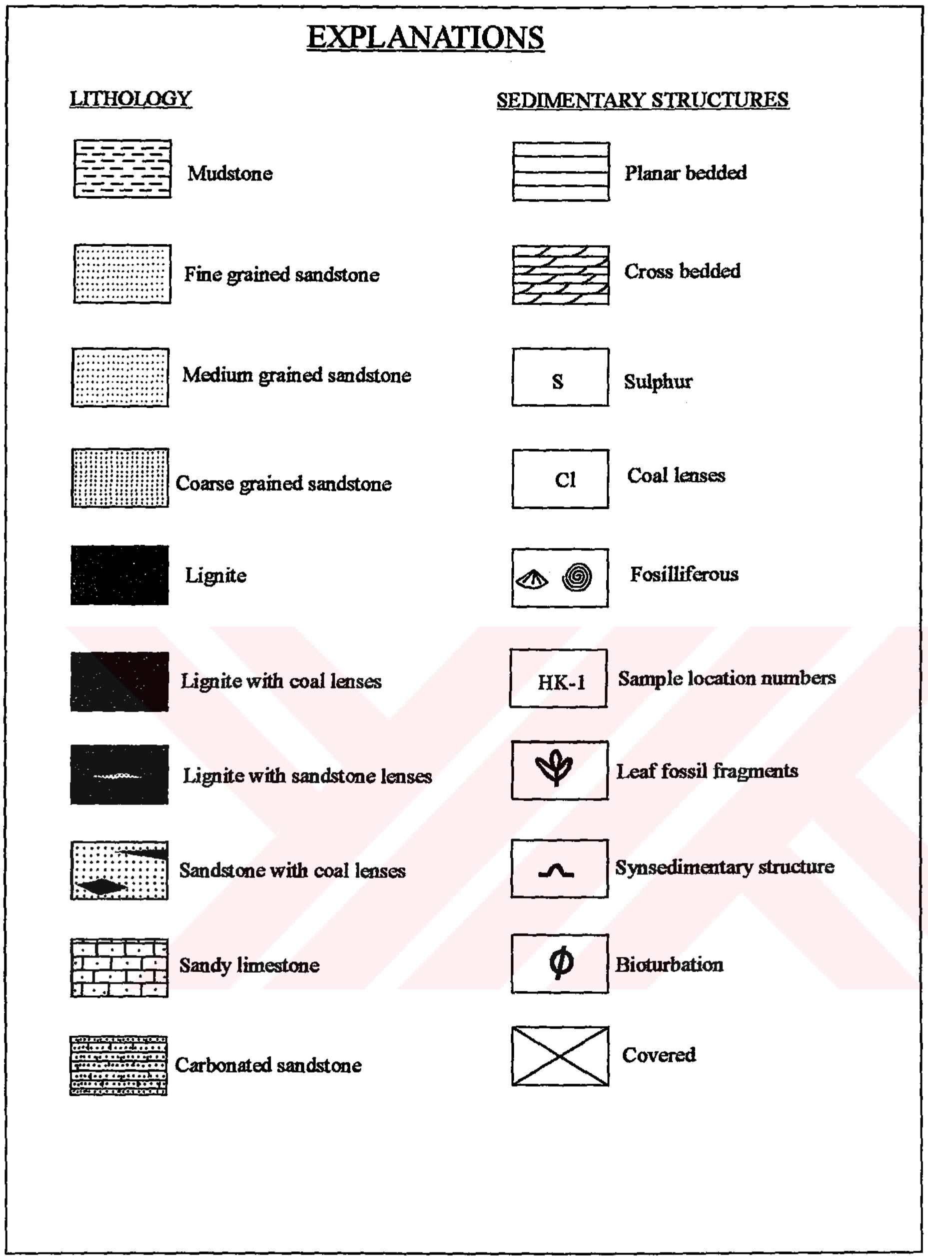


Figure 2.8 Legend of the Sections

# CHAPTER THREE

# PALYNOLOGY

## 3.1 Introduction

This chapter includes the palynological study of one hundred and thirty – five microscopic slides from coal, clay and mudstone.
The genera and species showed here are arranged alphabetically under the broad of trilete and monolete spores, gymnospermous saccate, gymnospermous – non saccate pollen, angiospermous pollen, fungal spores dinoflagellata and incertae cedis. Thomson & Pflug (1953)'s classification dominantly were used and also publications of Krutzsch to determine the spores.

## 3.2 Sample Processing

Following techniques processed 48 samples for quantitative counting. Firstly the samples were dried and crushed and about 10mg of sediment was sheredded and placed in a plastic pot.

Palynological preparations were made from collected samples by using standart HCL and HF treatments followed by oxidation with Schulze's solution and KOH. The samples were treated by using concentrated 30 millilitres of 32 % HCL for one day to remove carbonates and disaggregate clay. After the material was washed four times in a centrifuge, the residue was processed with concentrated 30 millilitres of 38-40 % HF for two days. After the solution centrifuged three times, the material was prepared by using the Schulze's solution. The samples mixed with 5 gr $KCLO_3$ and then 30 millilitres of 65 % nitric acid were added. The material was kept in the laboratory until it flushed. The solution was often controlled on the microscope whether it was prepared or not. When the samples were prepared, they were washed three or five times until the water was reasonably cleaned. The residue was put into a glass tube and added small amount of water. The solution was heated until 70 $^0$C. 2 grams of KOH were added into the solution and then it was immediately centrifuged three times. The residue was placed into a small bottle and small amount of water mixed with it. Then 4-5 drops alcohol was added into the bottle.

Some of the slides were steril and at least 100 identified pollen and spores from the others had been counted. Selected palynomorphs were photomicrographed with the help of Olympus microscope. A full list of the slides examined was present in the Appendix.

### 3.3 Systematic Palynology

#### 3.3.1 Spores

**Genus:** *Leiotriletes* (NAUMOVA, 1937) R. POT. & KREMP, 1954

**Type Species:** *Leiotriletes sphaerotriangulus* (LOOSE, 1932) R. POT. & KREMP, 1954

*Leiotriletes microadriennis* KRUTZSCH, 1959a

Plate I; figures 1 – 2

**Previously recorded occurence**: Sittler (1965) recorded this species in the Lower-Middle Oligocene of France. Nakoman (1966a) mention the occurences of the species may be observed up to the Oligocene of the Thrace Basin. Nakoman (1966b) recorded the species in the Eocene of Yozgat (Sorgun). According to Krutzsch & Vanhoorne (1977) it occurs from the Upper Paleocene to Upper Eocene in Belgium. Nickel (1996) mentions occurences in the Rhine Graben from the Upper Paleocene to Upper Eocene.

*Leiotriletes adriennis* (R. POT. & GELLETICH, 1933) KRUTZSCH, 1959a
Plate I; figures 3 – 6

**Previously recorded occurence:** According to Krutzsch (1962a) the species occurs in the Middle and Upper Oligocene (Upper Chattian), and occasionally in the Middle Miocene in German. Nakoman (1966b) reports the species in the Eocene Sorgun lignites. Konzálová (1973) mentions abundant occurences in the Miocene sediments in coal in the Central Europe. Planderova (1991) pointed out that it occurs in the Lower Miocene coal seams of Bohemia and Slovakia.

*Leiotriletes dorogensis* (KEDVES, 1960) KEDVES,1961
Plate I; figures 7 – 13

**Previously recorded occurence**: According to Kedves (1961) the species is present from the Sparnacien to Oligocene and Miocene of the Dorog Basin (France). In German Upper Egerian Krutzsch (1962a). According to Nakoman (1966a) the species are observed from the Eocene to Miocene of the Thrace Basin. Nakoman (1966b) indicates the species in the Eocene sediments of Sorgun area. Akyol (1971) reported the species from Lower Oligocene of Şile – İstanbul. Akyol (1980) mentions the species disappear after the Upper most of the Middle Oligocene. In the Upper Rhine the species occur in the Lower Eocene to Lower Miocene Graben (Nickel, 1996).

**Genus:** *Retitriletes* PIERCE, 1961

**Type Species:** R*etitriletes globosus* PIERCE, 1961

*Retitriletes fragilis* SCHULER & SITTLER, 1969
Plate II; figures 1 – 4

**Previously recorded occurence:** Schuler & Sittler (1969) mention occurences in the Montbrison Basin Oligocene (France). In the Trace coal seams, Batı (1996) recorded the species in the Upper Oligocene.

**Genus:** *Trilites* (COOKSON, 1947) COUPER, 1953

**Type Species:** *Trilites tuberculiformis* COOKSON, 1947

*Trilites multivallatus* (PF. *in* TH. & PF. 1953) KRUTZSCH, 1959a
Plate II; figures 5 – 7

**Previously recorded occurence**: Krutzsch (1967a) mentions its occurences in the Upper Oligocene – Middle Miocene of Germany. Chateauneuf (1980) mentions occurences in the Upper Middle Eocene of the Paris Basin (France). Ashraf & Mosbrugger (1995) indicate the species from the Lower Oligocene to Pliocene of the Lower Rhine Embayment (NW Germany). According to Nickel (1996) the species occurs from the Lower Oligocene to Upper Miocene of the Upper Rhine Graben.

*Trilites embriyonalis* KRUTZSCH, 1967a
Plate II; figure 8

**Previously recorded occurence:** It was recorded scarcely by Krutzsch (1967a) in the Miocene in Germany. Hochuli (1978) found the species in the Central and Western Paratethys. Planderova (1991) indicates that the species was being present between the Oligocene and Ottnangian in the West Carpatians.

**Genus:** *Polypodiaceoisporites* R. POT. 1956

**Type Species***:* *Polypodiaceoisporites specious* (R. POT. 1934) R. POT. 1956

*Polypodiaceoisporites lusaticus* KRUTZSCH, 1967a
Plate II; figures 9 – 10

**Previously recorded occurence:** Krutzsch (1967a) mentions occurences of the species in the Middle Oligocene and Lower Miocene of Germany. . In the Paris Basin (France) the species are present in the Upper most of the Middle Eocene (Chateauneuf, 1980). Nagy (1985) in Hungarian Egerian – Pannonian. Nickel (1996) indicates that the species was observed from the Middle Eocene to Middle Miocene of the Upper Rhine Graben.

**Genus:** *Baculatisporites* PF. & TH. *in* TH. &. PF. 1953

**Type Species:** *Baculatisporites primarius* (WOLFF, 1934) TH. &. PF. 1953

*Baculatisporites primarius* (WOLLF, 1934) ssp. *crassiprimarius* KRUTZSCH, 1967a
Plate II; figures 11 – 15

**Previously recorded occurence:** Krutzsch (1967a) mentions occurences of the species in the Upper Eocene – Pliocene of Germany.

*Baculatisporites primarius* (WOLLF, 1934) ssp. *oligocaenicus* KRUZSCH, 1967a
Plate II; figures 16 – 18

**Previously recorded occurence:** Krutzsch (1967a) reported that the species was present from the Upper Eocene to Lower Miocene of Germany. In the Western Paratethys the species occurs in the Oligocene (Hochuli, 1978).

*Baculatisporites nanus* (WOLLF, 1934) KRUTZSCH, 1959a
Plate II; figure 19

**Previously recorded occurence:** In Germany the species are present from the Middle Oligocene to Miocene (Krutzsch, 1967a). According to Ashraf & Mosbrugger (1995) in German Middle Oligocene and Pliocene.

**Genus:** *Echinatisporis* KRUTZSCH, 1959a

**Type Species:** *Echinatisporis longechinatus* KRUTZSCH, 1959a

*Echinatisporis* cf. *bockwitzensis* KRUTZSCH, 1963
Plate II; figures 20 – 21

**Remarks:** It differs from *Echinatisporites bockwitzensis* in its size. Size: 46-60μ

**Previously recorded occurence:** Gorin (1975) mentions occurences since the Upper Eocene till Lower Oligocene of the Grande Limagne Basin (France). Chateauneuf (1980) mentions occurences the Upper Eocene (Auversian – Ludian) of the Paris Basin. In the Upper Oligocene (Chattian) of the Lower Rhine Graben (NW Germany) (Ashraf & Mosbrugger, 1995). Akgün & Sözbilir (2000) reported the species from the Upper Oligocene of the SW Anatolian Molasse Basin (Turkey).

*Echinatisporis longechinus* KRUTZSCH, 1959a
Plate II; figures 22 – 25

**Previously recorded occurence:** Hochuli (1978) reported the species from the Upper Oligocene of the Central and Western Paratethys. Thiele – Pfeiffer (1980) mention occurences in the Miocene of the brown coal open- cast oder mine near Wackersdorf – Oberpfalz. According to Nickel (1996) the species is observed from the Middle Eocene to Miocene of the Upper Rhine Graben.

**Genus:** *Lusatisporis* KRUTZSCH, 1963

**Type Species:** *Lusatisporis punctatus* KRUTZSCH, 1963

*Lusatisporis perinatus* KRUTZSCH, 1963
Plate III; figures 1 – 3

**Previously recorded occurence**: The Tertiary of Trace Basin (Nakoman, 1966a). Ashraf & Mosbrugger (1995) mention occurences of the species in the Middle Miocene of Germany.

**Genus:** *Levigatosporites* IBRAHIM, 1933

**Type Species:** *Laevigatosporites vulgaris* (IBRAHIM, 1932) IBRAHIM, 1933

*Laevigatosporites haardti* (R. POT. & VEN. 1934) TH. & PF. 1953 ssp. *haardtioides* KRUTZSCH, 1967a
Plate III; figure 4

**Previously recorded occurences:** From the Oligocene to Pliocene in Germany Krutzsch (1967a).

*Laevigatosporites haardti* (R. POT. & VEN. 1934) TH. & PF. 1953
Plate III; figure 5 – 8

**Previously recorded occurence:** Thomson & Pflug (1953) mention occurences from the Paleocene to Miocene of Germany. Nakoman (1966a) indicates that the species may be observed from the Lower Lias to Tertiry of Thrace Basin. Nakoman (1966b) indicates the species in the Eocene of Yozgat (Sorgun) area.

**Genus:** *Verrucatosporites* PF. & TH. *in* TH. & PF. 1953

**Type Species:** *Verrucatosporites alienus* (R. POT. 1931c) TH. & PF. 1953

*Verrucatosporites favus* (R. POT. 1931c) TH. & PF. 1953
Plate III; figures 9 – 15

**Previously recorded occurence:** Nakoman (1966b) recorded the species in the Eocene sediments of Sorgun lignites. Krutzsch (1967a) mentions occurences of the species in the Middle Eocene- Pliocene of the Middle Europa. Akyol (1971) found the species in the Lower Oligocene of Şile – İstanbul (Turkey). Akyol (1980) mentions that the species may be observed in the Lower Miocene (Aquitanian).

*Verrucatosporites alienus* (R. POT. 1931c) TH. & PF. 1953
Plate III; figures 16 – 19

**Previously recorded occurence:** According to Nakoman (1996a) the species is present from the Middle Eocene to Lower Miocene of Thrace Basin. Nakoman (1966b) reported the species in the Eocene of Sorgun lignites. Akyol (1971) indicates the species in the Lower Oligocene of Şile – İstanbul coals. Krutzsch (1967a) determines that the species was present from the Upper Eocene to Miocene of Europa.

*Verrucatosporites histiopteroides* KRUTZSCH, 1962a *histiopteroides* KRUTZSCH, 1967a
Plate III; figure 20

**Previously recorded occurence:** Krutzsch (1967a) indicates that the species is present from the Middle Oligocene and exists through the Pliocene of Germany. According to Hochuli (1978) the species is observed from the Upper Oligocene to Lower Miocene of the Central and Western Paratethys. Nickel (1996) mentions that the species is observed from the Middle Oligocene to Upper Oligocene of the Upper Rhine Graben.

### 3.3.2 Pollen

**Gymnosperm Saccate Pollen**

**Genus:** *Pityosporites* SEWARD, 1914

**Type Species:** *Pityosporites antarcticus* SEWARD, 1914

*Pityosporites microalatus* (R. POT. 1931b) TH. & PF. 1953
Plate III; figures 21 – 24 , Plate IV; figure 1

**Previously recorded occurence:** According to Thomson & Pflug (1953); Hochuli (1978) the species occur from the Eocene to Pliocene of the Middle – East Europa. Nakoman (1966) indicates that the species occur from the Lower Lias to all Tertiary of Thrace Basin. Akyol (1971) reported the species in the Lower Oligocene of Şile İstanbul. Frederiksen (1980) recorded the species in the Eocene of North America. Chateauneuf (1980) mentions that the species was located in the Upper Eocene – Middle Oligocene of France.

*Pityosporites labdacus* (R. POT. 1931b) TH. & PF. 1953
Plate IV; figures 2 – 3

**Previously recorded occurence:** Thomson & Pflug (1953) mention the species from the Eocene to Pleistocene of the Middle Europa.

*Pityosporites absolutus* (THEIERG. 1937) TH. & PF. 1953
Plate IV; figure 4

**Previously recorded occurence:** According to Chateauneuf (1980) occurences of the species in the Lower and Middle Oligocene of the Paris Basin (France).

*Pityosporites strobipites* (WODEHOUSE, 1933) KRUTZSCH, 1971
Plate IV; figure 5

**Previously recorded occurence:** Krutzsch (1971) indicated that the species is belonged to the Middle and Late Tertiary of the Middle Europa.

**Genus:** *Podocarpidites* COOKSON, 1947

**Type Species:** *Podocarpidites ellipticus* COOKSON, 1947

*Podocarpidites libellus* (R. POT. 1931b) KRUTZSCH, 1971
Plate IV; figures 6 – 8

**Previously recorded occurence:** Nakoman (1966a) mentions the occurences of the species in the Tertiary of Thrace Basin. It is observed from the Middle Oligocene to Miocene of the Middle Europa (Krutzsch, 1971).

**Gymnosperm non- saccate pollen**

**Genus:** *Inaperturopollenites* PF. & TH. *in* TH. & PF. 1953

**Type Species:** *Inaperturopollenites dubius* (R. POT. & VEN. 1934) PF. & TH. *in* TH. & PF. 1953

*Inaperturopollenites magnus* (R. POT. 1934) PF. & TH. *in* TH. & PF. 1953
Plate IV; figure 9 – 10

**Previously recorded occurence:** Thomson & Pflug (1953) mention occurences of the species in the Middle – Late Tertiary of the Middle Europa. According to Nakoman (1966a) the species may be observed all the Tertiary of Thrace Basin. Akyol (1971) recorded the species in the Lower Oligocene of Şile – İstanbul coals.

*Inaperturopollenites dubius* (R. POT. & VEN. 1934) PF. & TH. *in* TH. & PF. 1953
Plate IV; figure 11 – 14

**Previously recorded occurence:** Thomson & Pflug (1953) recorded occurences of the species from the Paleocene to Upper Pliocene of the Middle Europa. According to Nakoman (1966a) the species may be present all the Tertiary of Tharace Basin. Nakoman (1966b) indicated the species inthe Eocene sediments of Sorgun area. Akyol (1971) reported the species in the Lower Oligocene sediments of Şile – İstanbul.

*Inaperturopollenites hiatus* (R. POT. 1931b) PF. & TH. *in* TH. & PF. 1953
Plate IV; figure 15 – 18

**Previously recorded occurence:** According to Nakoman (1966a) the species is present all the Tertiary of Thrace Basin. Moreover Nakoman (1966b) recorded the species in the Eocene sediments of Sorgun lignites. Akyol (1971) reported the species in the Lower Oligocene sediments of Şile – İstanbul. Snopková (1983) mentions that the species occured in the Rupelian frequently and Middle Miocene of Carpatians. Mohr (1984) mentioned the species from the Eocene to Pliocene of Germany.

*Inaperturopollenites polyformosus* (THEIERG. 1937) TH. & PF. 1953
Plate IV; figure 19 – 20

**Previously recorded occurence:** Nakoman (1966a) mentions that the species generally is present from the Oligocene to Pliocene of Thrace Basin. As decribed by Krutzsch (1971) from the Middle Oligocene to Pliocene of Germany.

**Genus :** *Sciadopityspollenites* (RAATZ, 1937) R. POT. 1958

**Type Species:** *Sciadopityspollenites serratus* (R. POT. & VEN. 1934) THEIERG. 1937

*Sciadopityspollenites serratus* (R. POT. & VEN. 1934) THEIERG. 1937
Plate IV; figure 21

**Previosly recorded occurence:** Krutzsch (1971) described from the Upper Eocene to Pliocene of the Middle East Europa. Chateauneuf (1980) reported the species from the Upper Eocene to Lower Oligocene of the Paris Basin. Ashraf & Mosbrugger (1995) recorded the same palynological zone of the Lower Rhine Embayment (NW Germany).

**Angiosperm Pollen**

**Genus:** *Cycadopites* WODEHOUSE, 1933

**Type Species:** *Cycadopites follicularis* WILSON & WEBSTER, 1946

*Cycadopites gracilis* (WODEHOUSE, 1933) KRUTZSCH, 1970
Plate IV; figures 22 – 24

**Previously recorded occurence**: Gorin (1974) recorded the species in the Oligocene of Grande Limagne (France).

**Genus:** *Monogemmites* KRUTZSCH, 1970

**Type Species:** *Monogemmites gemmatus* (COUPER, 1960) KRUTZSCH, 1970

*Monogemmites pseudosetarius* (WEYLAND & PFLUG, 1957) KRUTZSCH, 1970
Plate IV; figure 25, Plate V; figures 1 – 3

**Previosly recorded occurence:** Nakoman (1966a) mentions that occurences of the species were restricted Sannoisian (the Lowest part of the Oligocene). Krutzsch (1970) reported occurences of the species from the Oligocene to Pliocene of the Middle Europa.

**Genus:** *Spinozonocolpites* (MÜLLER, 1968) MÜLLER et al. 1987

**Type Species:** *Spinozonocolpites echinatus* MÜLLER, 1968

*Spinozonocolpites echinatus* MÜLLER, 1968
Plate V; figures 4 – 5

**Previously recorded occurence:** Müller (1968) mentions occurences of the species from the Tertiary to recent of the Western Sarawak.

*Spinozonocolpites* sp.
Plate V; figures 6 a, b

**Remarks:** Lenght 40µm, width 32µm (excluding spines) Sexine columellate, design finely granulate, punctate. Maximum lenght of the spines is 5µm, width, 3µm. All of the ornamental elements are spherical.

**Genus:** *Longapertites* VAN HOEKEN KLINKENBERG, 1964

**Type Species:** *Longapertites marginatus* VAN HOEKEN KLINKENBERG, 1964

*Longapertites* sp.
Plate V; figures 7 – 10

**Remarks:** Lenght 42- 50µm, width 28- 38µm. Proximal face straight or slightly convex, distal face arched. Sulcus extends the full lenght of the distal face. Sexine has between reticulate and punctate.

**Genus:** *Monoporopollenites* MEYER, 1956

**Type Species:** *Monoporopollenites gramineoides* MEYER, 1956

*Monoporopollenites gramineoides* MEYER, 1956
Plate V; figures 11 – 13

**Previously recorded occurence:** According to Nakoman (1966a) the species belongs to the Upper Tertiary as a whole. The species is rare in the Oligocene sediment of Europa and is better known in the Miocene and Pliocene (Krutzsch, 1967b). Ashraf & Mosbrugger (1995) mention that the species is observed in the Miocene of Germany.

**Genus:** *Sparganiaceaepollenites* THEIERG. 1937

**Type Species:** *Sparganiaceaepollenites convexus* THEIERG. 1937

*Sparganiaceaepollenites polygonalis* THEIERG. 1937
Plate V; figures 14 – 16

**Previously recorded occurence:** Hochuli (1978) mentions the occurences of the species in the Middle Oligocene of the Western Paratethys and also Krutzsch (1970) recorded the species in the Middle Oligocene of the Middle Europa.

*Sparganiaceaepollenites neogenicus* KRUTZSCH, 1970
Plate V; figures 17 – 20

**Previously recorded occurence:** Krutzsch (1970) indicates that the species was present from the Oligocene to Pleistocene of the Middle Europa.

**Genus:** *Aglaoreidia* (ERDTMAN, 1960) FOWLER, 1971

**Type Species:** *Aglaoreidia cyclops* ERDTMAN, 1960

*Aglaoreidia cyclops* EDTMAN, 1960
Plate V; figures 21 – 24

**Previously recorded occurence:** Hochuli (1978) mentions occurences of the species from the Lower Oligocene to Middle Oligocene of the Central and Western Paratethys. Chateauneuf (1980) recorded the species from the Upper Eocene to Uppermost Lower Oligocene of the Paris Basin. Chateauneuf – Cavagnetto – Meyer & Sittler and Pierre in Vinken (1988) mention the species from the Lower Oligocene to Middle Oligocene of France. According to Schuler in Vinken (1988) the species is present from the Upper Eocene to Middle Oligocene of the Rhine Graben. It is characteristic form for the Upper Eocene of England. Fowler in Vinken (1988) and Nickel (1996) mentioned the species from the Middle Eocene to Middle Oligocene of the Upper Rhine Graben.

**Genus:** *Dicolpopollis* PFLANZ, 1956

**Type Species:** *Dicolpopollis kockelii* PFLANZ, 1956

*Dicolpopollis kockelii* PFLANZ, 1956
Plate V; figure 25 – 28

**Previously recorded occurence:** Nakoman (1966a) recorded the species in the Upper Oligocene of the Thrace Basin. It is generally considered to range from the Middle Eocene to Middle Oligocene of Germany (Krutzsch, 1967b). Akyol (1971) reported the species in the Lower Oligocene of Şile- İstanbul (Turkey). According to Wilkinson – Bazley & Boulter (1980) the species although not restricted to the Oligocene, occur only in NW European the Oligocene deposits. Chateauneuf – Cavagnetto – Meyer & Sittler in Vinken (1988) studied Paleogene sediments of the

Paris Basin (France). They mention occurences of the species from the Upper Eocene to Lower Middle Oligocene. Olliver – Pierre in Vinken (1988) recorded the species from the Lower Oligocene to Middle Oligocene of the Armorican Massif (France). Schuler in Vinken (1988) indicates that the species occured from the Middle Oligocene to Upper Oligocene of the Rhine Graben. According to Roche in Vinken (1988) it is characteristic species of the Middle Oligocene in Belgium. Ediger et al. (1989) studied the *Calamus* – like disulcate pollen grains. The authors showed the stratigraphic distribution of *Dicolpopollis kockelii*. According to authors stratigraphic distribution of *Dicolpopollis kockeli is* the low frequencies in the Upper Eocene. It is abundant in the Upper Oligocene and reduces to the Miocene. Akgün & Sözbilir (2000) reported the species in the Upper Oligocene of SW Anatolian Molasse Basin.

**Genus:** *Triatriopollenites* PF. *in* TH. & PF. 1953

**Type Species:** *Triatriopollenites rurensis* PF. & TH. *in* TH. & PF. 1953

*Triatriopollenites pseudorurensis* PF. & TH. *in* TH. & PF. 1953
Plate V; figures 29 – 32

**Previously recorded occurence:** Nakoman (1966a) mentions occurences of the species in the Tertiary of the Thrace Basin (Turkey). Moreover Nakoman (1966b) recorded the species in the Eocene sediments of Sorgun lignites. Akyol (1980) reported the species in the Eocene of Çorum – Bayat (Turkey).

*Triatriopollenites rurensis* PF. & TH. *in* TH. & PF. 1953
Plate V; figures 33 – 37

**Previously recorded occurence**: Thomson & Pflug (1953) mention occurences of the species from the Eocene to Pliocene of the Middle Europa. Nakoman (1966b) recorded the species in the Eocene sediments of Sorgun lignites.

*Triatriopollenites bituitus* (R. POT. 1931a) TH. & PF. 1953
Plate VI; figures 1 – 4

**Previously recorded occurence:** From the Eocene to Pliocene of the Middle Europa Thomson & Pflug (1953).

*Triatriopollenites coryphaeus* (R. POT. 1931b) TH. & PF. 1953
Plate VI; figures 5 – 10

**Previously recorded occurence:** Akyol (1971) found it in the Lower Oligocene of Şile – İstanbul. Akgün & Sözbilir (2000) recorded the species in the Upper Oligocene of SW Anatolian Molasse Basin.

**Genus:** *Momipites* WODEHOUSE, 1933

**Type Species:** *Momipites coryloidites* WODEHOUSE, 1933

*Momipites punctatus* (R. POT. 1931b) NAGY, 1969
Plate VI; figures 11 – 15

**Previously recorded occurence:** Most authors report occurences in the Paleogene and mainly theLower and Middle Miocene (Konzálová, 1976) of the Central Europa. From the Middle Oligocene to Lower Miocene of the Western Paratethys (Hochuli, 1978). Snopková (1983) mentions sporadical occurences in the Upper Eocene and Oligocene of the Inner – Carpathian depressions. Nickel (1996) records from the Lower Eocene to Upper Miocene of the Upper Rhine Graben.

*Momipites quietus* (R. POT. 1931b) NICHOLS, 1973
Plate VI; figures 16 – 17

**Previously recorded occurence:** According to Hochuli (1978) the species can be observed from the Lower Paleocene to Lower Miocene. From the Lower Paleocene to Middle Oligocene of the Upper Rhine Graben (Nickel, 1996).

*Momipites* sp.
Plate VI; figures 18 a,b – 22

**Remarks:** Triporate or Triatriate pollen grain, shape is triangular. Three pores are observed on the corner in polar view. Pores are small, situated on the equatoral corners without anulus and labrum. The range of the diameter is 16-22µm. On the corners , there are dark areas like a ring surrounding the pores.

**Genus:** *Corsinipollenites* NAKOMAN, 1965

**Type Species:** *Corsinipollenites oculis* ssp.*noctis* (THEIERG. 1940) NAKOMAN, 1965

*Corsinipollenites oculis* ssp. *noctis* (THEIERG. 1940) NAKOMAN, 1965
Plate VI; figures 23 – 24

**Previously recorded occurence:** Nakoman (1966a) occurences of the species in the Tertiary of Thrace Basin. Krutzsch (1968) recorded the species from the Middle Eocene to Pliocene of Europa. Akyol (1971) indicates the species in the Lower Oligocene of Şile – İstanbul.

**Genus:** *Triporopollenites* PF. & TH. *in* TH. & PF. 1953

**Type Species:** *Triporopollenites coryloides* PF. & TH. *in* TH. & PF. 1953

*Triporopollenites robustus* (MÜRRIG. & PF. 1951) PF. *in* TH. & PF. 1953
Plate VI; figure 25

**Previously recorded occurence:** It occurs commonly from the Paleocene to Upper Eocene and rarely Miocene of the Middle Europa (Thomson & Pflug, 1953 and Krutzsch & Vanhoorne, 1977).According to Nakoman (1966a) the species is present in the Lower Tertiary of Thrace Basin.

*Triporopollenites megagranifer* (R. POT. 1951) TH. & PF. 1953
Plate VI; figure 26

**Previously recorded occurence:** Thomson & Pflug (1953) indicate the species from the Paleocene to Upper Miocene of the Middle Europa. From the Paleocene to Lower Oligocene of Thrace Basin (Nakoman, 1966a).

**Genus:** *Olaxipollis* KRUTZSCH, 1962b

**Type Species:** *Olaxipollis matthesii* KRUTZSCH, 1962b

*Olaxipollis matthesii* KRUTZSCH, 1962b
Plate VI; figure 27 – 32

**Previously recorded occurence**: From the Middle Eocene to Middle Miocene of the Middle and East Europa (Krutzsch, 1962b).

**Genus:** *Trivestibulopollenites* PF. *in* TH. & PF. 1953

**Type Species:** *Trivestibulopollenites betuloides* PF. *in* TH. & PF. 1953

*Trivestibulopollenites betuloides* PF. *in* TH. & PF. 1953
Plate VI; figure 33 – 36

**Previously recorded occurence:** In Miocene and Pliocene of the Middle Europa Thomson& Pflug (1953). Krutzsch (1958) indicates the species in the Middle Oligocene of the Middle Europa.

*Trivestibulopollenites prominens* PF. *in* TH. & PF. 1953
Plate VI; figures 37 – 38

**Previously recorded occurence**: Nakoman (1966a) suggested the species in the Tertiary of theThrace Basin.
**Genus:** *Subtriporopollenites* PF. & TH. *in* TH. & PF. 1953

**Type Species:** *Subtriporopollenites anulatus* PF. & TH. *in* TH. & PF. 1953

*Subtriporopollenites anulatus* PF. &TH. *in* TH. & PF. 1953 ssp. *nanus* PF. & TH.*in* TH. & PF. 1953
Plate VI; figures 39 – 44

**Previously recorded occurence:** Thomson & Pflug (1953), Krutzsch & Vanhoorne (1977) indicate the species from the Upper Paleocene to Upper Eocene of Europa. Akgün & Sözbilir (2000) recorded the species in the Upper Oligocene of SW Anatolian Molasse basin.

*Subtriporopollenites simplex* (R. POT. & VEN. 1934) TH. & PF. 1953 ssp. *simplex* (R. POT. & VEN 1934) TH. & PF. 1953
Plate VI; figures 45 – 49

**Previously recorded occurence:** According to Nakoman (1966a) the species is present all the Ter tiary of the Thrace Basin. Akyol (1971) recorded the species in the Lower Oligocene of Şile – İstanbul. Hochuli (1978) mentions occurences of the species from the Lower Oligocene to Lower Miocene of the Central and Western Paratethys. Chateauneuf (1980) reported the species from the Lower Oligocene to Middle Oigocene of the Paris Basin (France). From the Lower Oligocene to Miocene of Belgium (Roche in Vinken, 1988). Nickel (1996) recorded the species from the Lower Oligocene to Pliocene of the Upper Rhine Graben.

*Subtriporopollenites latiporatus* CHATEAUN. 1980
Plate VII; figures 1 – 3

**Previously recorded occurence:** Chateauneuf (1980) mentions occurences of the species from the Upper most Middle Eocene to Upper Eocene of the Paris Basin.

*Subtriporopollenites constans* PF. *in* TH. & PF. 1953
Plate VII; figures 4 – 6

**Previously recorded occurence:** Thomson & Pflug (1953) recorded the species from the Paleocene to Lower Oligocene of the Middle Europa. Nakoman (1966a) mentions that the species is observed up to the Oligocene. According to the Kedves (1970) the species are present in the Lower Eocene sediments of France. According to Akyol (1980) the species disappear after the Upper Eocene. However the author indicates that the species can be observed the Lower Oligocene of Thrace Basin.

**Genus:** *Compositoipollenites* R. POT. 1960

**Type Species:** *Compositoipollenites rhizophorus* (R. POT. 1934) R. POT. 1960

*Compositoipollenites rhizophorus* (R. POT. 1934) R. POT. 1960 ssp.
*burghasungensis* (MÜRRIG. & PF. 1951) MÜRRIG. & PF. *in* TH. & PF. 1953
Plate VII; figures 7 – 8

**Previously recorded occurence:** Thomson & Pflug (1953) recorded from the Upper Paleocene to Upper Eocene of the Middle Europa. Gruas – Cavagnetto (1968) mentioned the species from the Lower Eocene to Upper Eocene of the Paris Basin.
Kedves (1970) reported the species from the Upper Paleocene to Lower Eocene of the Paris region. Nickel (1996) mentions from the Upper Paleocene to Upper Eocene of the Upper Rhine Graben.

**Genus:** *Intratriporopollenites* PF. & TH. *in* TH. & PF. 1953

**Type Species:** *Intratriporopollenites instructus* (R. POT. 1931) TH. & PF. 1953

*Intratriporopollenites indubitalibis* (R. POT. 1934) PF. & TH. *in* TH . & PF. 1953
Plate VII; figures 9 – 12

**Previously recorded occurence:** The species can be present during the Tertiary of the Middle Europa (Thomson & Pflug, 1953). The species is observed in the Lower Tertiary of Thrace Basin (Nakoman, 1966a).

*Intratriporopollenites instructus* (R. POT. 1931b) TH. & PF. 1953
Plate VII; figures 13 – 17

**Previously recorded occurence**: Krutzsch (1967b) suggests that it is rarely present in the Middle Oligocene, absent in theUpper Oligocene and common in the Miocene of Europa. Wilkinson & Boulter (1980) mention occurences of the species from the Lower Oligocene to Miocene of Europa. Schuler in Vinken (1988) recorded from the Lower to Middle Oligocene of the Rhine Graben

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**Genus:** *Polyporopollenites* PF. *in* TH. & PF. 1953

**Type Species:** *Polyporopollenites undulosus* (WOLFF, 1934) TH. & PF. 1953

*Polyporopollenites undulosus* (WOLLF, 1934) TH. & PF. 1953
Plate VII; figures 18 – 21

**Previously recorded occurence:** Krutzsch (1957) mentions occurences of the species from the Upper Paleocene to recent of the Middle Europa. Akyol (1971) recorded the species in the Lower Oligocene sediments of Şile – İstanbul. From the Upper most Middle Eocene to Middle Oligocene of the Paris Basin (Chateauneuf, 1980).

*Polyporopollenites carpinoides* PF. *in* TH. & PF. 1953
Plate VII; figures 22 – 24

**Previously recorded occurence:** The middle and Late Tertiary of the Middle Europa (Thomson & Pflug, 1953).

*Polyporopollenites stellatus* (R. POT. & VEN. 1934) TH. & PF. 1953
Plate VII; figures 25 – 26

**Previously recorded occurence:** Thomson & Pflug (1953) mention the occurences of the species from the Middle Eocene to Pleistocene of the Middle Europa. According to Nakoman (1966a) the species is present from the Eocene to Pliocene of Thrace Basin. Hochuli (1978) reported the species in the Middle Oligocene of the Central and Western Paratethys.

**Genus:** *Polyvestibulopollenites* PF. *in* TH. & PF. 1953

**Type Species:** *Ployvestibulopollenites verus* (R. POT. 1931a) TH. & PF. 1953

*Polyvestibulopollenites verus* (R. POT. 1931) TH. & PF. 1953
Plate VII; figure 27 – 29

**Previously recorded occurence:** From the Eocene to Pliocene of the Middle Europa Thomson & Pflug (1953).

**Genus:** *Boehlensipollis* KRUTZSCH, 1962b

**Type Species:** *Boehlensipollis hohli* KRUTZSCH, 1962b

*Boehlensipollis hohli* KRUTZSCH, 1962b
Plate VII; figure 30

**Previously recorded occurence:** Hochuli (1978) recorded the species from the Lower and Middle Oligocene of the Central and Western Paratethys. According to Wilkinson – Bazley & Boulter (1980) the species was restricted to the Oligocene of the Lough Neagh Clays. Frederiksen (1980) reported the species from the Middle Eocene to Lower Oligocene of South Carolina (America). Gorin (1975), Chateauneuf (1980) and Olliver- Pierre in Vinken (1988), studied in France. They mention occurences of the species from the Lower to Middle Oligocene. According to Schuler in Vinken (1988) the species is characteristic form for the Middle Oligocene of the Rhine Graben. Roche in Vinken (1988) mentions that the species is characteristic form for the Middle Oligocene of Belgium. From the Lower Oligocene to Middle Oligocene of the Upper Rhine Graben Nickel (1996). Schalke in Vinken (1988) recorded the species in the Middle Oligocene of Netherlands.

**Genus:** *Myrtaceidites* COOKSON & PIKE, 1954

**Type Species:** *Myrtaceidites mesonesus* COOKSON & PIKE, 1954

*Myrtaceidites mesonesus* COOKSON & PIKE, 1954
Plate VII; figures 31 – 36

**Previously recorded occurence**: Cookson & Pike (1954) indicate the species from the Eocene to Pliocene of Australia.

**Genus:** *Slowakipollis* KRUTZSCH, 1962b

**Type Species:** *Slowakipollis cechovici* (PACLTOVA, 1958) KRUTZSCH, 1962b

*Slowakipollis hipophäeoides* KRUTZSCH, 1962b
Plate VII; figures 37 a,b – 38

**Previously recorded occurence:** According to Hochuli (1978) the species can be present from the Middle Oligocene to Lower Miocene of the Central and Western

Paratethys. Kirchner (1984) recorded the species from the Upper Oligocene to Pliocene of the Southern Bavarian. Roche in Vinken (1988) recorded the species in the Middle Oligocene of Belgium. It is observed in the Middle Oligocene of Netherlands Schalke in Vinken (1988). According to Schuler in Vinken (1988) it can be present in the Lower and Middle Oligocene of the Rhine Graben.

**Genus:** *Cupaniëidites* COOKSON & PIKE , 1954

**Type species:** *Cupaniëidites major* COOKSON & PIKE , 1954

*Cupaniëidites eucalyptoides* KRUTZSCH, 1962a
Plate VII; figures 39 – 40

**Previously recorded occurence:** Cookson & Pike (1954) reported the species in the Eocene. Krutzsch (1962a) mentions occurences of the species in the Middle Oligocene of Germany. It rarely is observed in the Upper Eocene sediments of the Paris Basin (Chateauneuf, 1980).

**Genus:** *Pentapollenites* KRUTZSCH, 1958

**Type Species:** *Pentapollenites pentangulus* (PF. *in* TH. & PF. 1953) KRUTZSCH, 1958a

*Pentapollenites pentangulus* (PF.*in* TH. & PF. 1953) KRUTZSCH, 1958
Plate VII; figures 41 – 42

**Previously recorded occurence:** From the Middle Eocene to Lower Oligocene of the Paris Basin (Chateauneuf, 1980). According to Nickel (1996) the species is present from the Paleocene to Middle Oligocene of the Upper Rhine Graben.

**Genus:** *Porocolpopollenites* PF. *in* TH. & PF. 1953

**Type Species:** *Porocolpopollenites vestibuloformis* PF. *in* TH. & PF. 1953

*Porocolpopollenites vestibulum* (R. POT. 1931a) TH. & PF. 1953
Plate VII; figures 43 – 45

**Previously recorded occurence**: From the Middle Eocene to Pliocene of the Middle Europa (Thomson & Pflug, 1953). Akyol (1971) reported the species in the Lower Oligocene sediments of Şile – İstanbul.

*Porocolpopollenites triangulus* (R. POT. 1931a) TH. & PF. 1953
Plate VII; figure 46

**Previously recorded occurence:** Thomson & Pflug (1953) mention occurences of the species the Middle and Late Tertiary of the Middle Europa.

**Genus:** *Tricolpopollenites* PF. & TH. *in* TH. & PF. 1953

**Type Species:** *Tricolpopollenites parmularius* (R. POT. 1934) TH. & PF. 1953

*Tricolpopollenites henrici* (R. POT. 1931a) TH. & PF. 1953
Plate VII; figure 47; Plate VIII; figure 1

**Previously recorded occurence**: Abundant in the Paleogene, mainly in the Oligocene (Thomson & Pflug, 1953). According to Nakoman (1966a) the species occur all the Tertiary.

*Tricolpopollenites densus* PF. *in* TH. & PF. 1953
Plate VIII; figures 2 – 3

**Previously recorded occurence:** Chateauneuf (1980) recorded the species from the Upper most Eocene to Lower – Middle Oligocene of the Paris Basin.

*Tricolpopollenites retiformis* PF. & TH. *in* TH. & PF. 1953
Plate VIII; figures 4 – 6

**Previously recorded occurence**: This species occurs from the Upper Paleocene to recent of the Middle Europa (Thomson & Pflug, 1953). According to Nakoman (1966a) the species may be observed all the Tertiary.

*Tricolpopollenites microhenrici* (R. POT. 1931b) TH. & PF. 1953
Plate VIII; figures 7 – 11

**Previously recorded occurence:** Thomson & Pflug (1953) mention occurences of the species from the Eocene to Pliocene of the Middle Europa. Akyol (1971) recorded the species in the Lower Oligocene sediments of Şile – İstanbul.

*Tricolpopollenites liblarensis* (TH. 1950) TH. & PF. 1953 ssp. *fallax* (R. POT. 1934) TH. & PF. 1953
Plate VIII; figures 12 – 13

**Previously recorded occurence:** Thomson & Pflug (1953) report occurences of the species from the Eocene to Miocene of the Middle Europa. Nakoman (1966a) indicates that the species occured in the Lower Tertiary of Thrace Basin.

*Tricolpopollenites akgünii* n. sp.
Plate VIII; figures 14 – 17

**Holotype:** Plate VIII, Figure 15; 32µm; Sample no: Tç$_3$- 99, Slide no: Tç$_3$- 99$_{(b)}$

**Diagnosis:** Size range 32- 34µm; amp prolate in polar, spheroidal in equatorial view; tricolpate, colpi distinct, fairly long, exine thick, surface sculpture coarsely between granulate and verrucate.

**Description:** Pollen grains are not small. Amp is round in eqatorial and ellisoidal in polar view. It has distinctly tricolpate. Colpi is rather long. It extends almost up to poles. Exin is thick. Ornamentation consists of coarse granula and verrucae.

**Comparison:** *Verrutricolporites magnotectatus* ROCHE & SCHULER (1976) differs from *Tricolpopollenites akgünii* in having pores and comparatively finer sculptural elements. *Tricolpopollenites akgünii* is a tricolpate pollen. However *Tricolpopollenites akgünii* has coarse granula and verrucae ornaments.

**Type Locality:** Tokça formation, Lower – Middle Oligocene, In Tokça village (Turkey).

**Genus:** *Aceripollenites* NAGY, 1969

**Type species**: *Aceripollenites rotundus* NAGY, 1969

*Aceripollenites reticulatus* NAGY, 1969
Plate VIII; figure 18

**Previously recorded occurence:** Nagy (1969) mentions occurences of the species from the Lower most Upper Oligocene to Middle Miocene of Hungary.

**Genus:** *Polycolpites* COUPER, 1953

**Type Species:** *Polycolpites clavatus* COUPER, 1953

*Polycolpites specious* DUTTA & SAH, 1970
Plate VIII; figures 19 – 21

**Previously recorded occurence:** Dutta & Sah (1970) mention occurences of the species in the Lower Eocene substratum of the Shillong Plateau (India).

*Polycolpites* sp.
Plate VIII; figures 22 – 23

**Remarks:** Measuring diameter is 24-26μm. Amp is subcircular or circular. 4-6 polycolpate, Surface is chagrenate and granulate. It has thick exine.

**Genus:** *Tricolporopollenites* PF. & TH. *in* TH. & PF. 1953

**Type Species:** *Tricolporopollenites dolium* (R. POT. 1931b) TH. & PF. 1953

*Tricolporopollenites villensis* (TH. 1950) TH. & PF. 1953
Plate VIII; figures 24 – 25

**Previously recorded occurence**: Thomson & Pflug (1953) reported the species in the Middle Eocene and Miocene of the Middle Europa.

*Tricolporopollenites cingulum* (R. POT. 1931b) TH. & PF. 1953 ssp. *fusus*
(R. POT. 1934) TH. & PF. 1953
Plate VIII; figures 26 – 28

**Previously recorded occurence:** Thomson & Pflug (1953) mention abundant occurences during the Late Paleogene. According to Nakoman (1966a) the species occur in the Lower Tertiary.

*Tricolporopollenites cingulum* (R. POT. 1931b) TH. & PF. 1953 ssp. *pusillus*
(R. POT. 1934) TH. & PF. 1953
Plate VIII; figures 29 – 30

**Previously recorded occurence:** Thomson & Pflug (1953) recorded occurences of the species from the Paleogene and Neogene of Middle Europa. Akyol (1971) recorded the species in the Lower Oligocene of Şile – İstanbul.

*Tricolporopollenites cingulum* (R. POT. 1931b) TH. & PF. 1953 ssp. *oviformis*
(R. POT. 1931b) TH. & PF. 1953
Plate VIII; figure 31

**Previously recorded occurence:** In the Paleogene of Middle Europa (Thomson & Pflug, 1953).

*Tricolporopollenites megaexactus* (R. POT. 1931b) TH. & PF. 1953 ssp.*brühlensis*
(TH . 1950) TH. & PF. 1953
Plate VIII; figures 32 – 35

**Previously recorded occurence:** Thomson & Pflug (1953) recorded from the Lower Eocene to Pliocene of the Middle Europa.

*Tricolporopollenites megaexactus* (R. POT. 1931b) TH. & PF. 1953 ssp. *exactus*
(R. POT. 1931b) TH. & PF. 1953
Plate VIII; figures 36 – 38

**Previously recorded occurence:** Ashraf & Mosbrugger (1995) mention occurences of the species from the Middle Eocene to Pliocene of the Lower Rhine Embayment (NW Germany).

*Tricolporopollenites steinensis* PF. *in* TH. & PF. 1953
Plate VIII; figure 39 – 41

**Previously recorded occurence:** Nakoman (1966a) reports the species in the Tertiary of the Thrace Basin.

*Tricolporopollenites pseudocingulum* (R. POT. 1931a) TH. & PF. 1953
Plate VIII; figures 42 – 45

**Previously recorded occurence:** Thomson & Pflug (1953) suggest from the Paleocene to Pliocene of the Middle Europa.

*Tricolporopollenites pacatus* PF. *in* TH. & PF. 1953
Plate VIII; figures 46 – 48

**Previously recorded occurence:** According to Kedves (1963) occurences of the species from the Lower Eocene to Upper Eocene of Hungary. From the Upper Eocene to Upper Oligocene of Thrace Basin (Nakoman, 1966a). Akgün & Akyol (1999) suggested it in the Middle Miocene of the Büyük Menderes Graben.

*Tricolporopollenites euphorii* (R. POT. 1931a) TH. & PF. 1953
Plate IX; figures 1 – 2

**Previously recorded occurence:** Thomson & Pflug (1953) mention occurences of the species from the Lower Eocene to Pliocene of the Middle Europa.

*Tricolporopollenites eschweilerensis* PF. & TH. *in* TH. & PF. 1953
Plate IX; figures 3 – 4

**Previously recorded occurence:** According to Kedves (1963) the species is present from the Lower Eocene to Upper Eocene of Hungary. According to Nakoman (1966a) the species occur all the Tertiary of Thrace Basin.

*Tricolporopollenites helmstedtensis* PF. & TH. *in* TH. & PF. 1953
Plate IX; figures 5 – 7

**Previously recorded occurence:** Nakoman (1966a) mentions occurences of the species all the Tertiary of Thrace Basin. Akyol (1971) reported the species in the Lower Oligocene of Şile –İstanbul.

*Tricolporopollenites marcodurensis* PF. & TH. *in* TH. & PF. 1953
Plate IX; figures 8 – 11

**Previously recorded occurence:** Nickel (1996) indicates the species from the Lower Eocene to Upper Miocene of the Upper Rhine Graben.

*Tricolporopollenites kruschi* (R. POT. 1931c) TH. & PF. 1953 ssp. *analepticus*
( R. POT. 1931c ) TH. & PF. 1953
Plate IX; figure 12

**Previously recorded occurence:** Thomson & Pflug (1953) recorded the species from the Lower Eocene to Miocene of the Middle Europa.

*Tricolporopollenites kruschi* (R. POT. 1931c) TH. & PF. 1953 ssp. *accessorius*
( R. POT. 1934 ) TH. & PF. 1953
Plate IX; figure 13 – 14

**Previously recorded occurence:** From the Lower Eocene to Pliocene of the Middle Europa (Thomson & Pflug, 1953).

*Tricolporopollenites kruschi* (R. POT. 1931c) TH. &PF. 1953 ssp. *pseudolaesus* (POT. 1931c) TH & PF. 1953

Plate IX; figures 15 – 17

**Previously recorded occurence**: Thomson & Pflug (1953) report the species from the Lower Eocene to Miocene of the Middle Europa. Akyol (1971) recorded the species in the Lower Oligocene of Şile – İstanbul.

*Tricolporopollenites* cf. *kruschi* (R. POT. 1931c) TH. & PF. 1953

Plate IX; figures 18 – 20

**Previously recorded occurence**: Thomson & Pflug (1953) mention occurences of the species from the Lower Eocene to Miocene of the Middle Europa.

*Tricolporopollenites genuinus* (R. POT. 1934) TH. & PF. 1953

Plate IX; figures 21 – 23

**Previously recorded occurrence:** Nakoman (1966a) mentions that the species occur in the Lower Tertiary of Thrace Basin. Gruas - Cavagnetto (1968) mentions that the species occurred from the Danian to Pliocene of the Paris Basin.

*Tricolporopollenites* cf. *baculoferus* PF. *in* TH. & PF. 1953

Plate IX; figure 24

**Remarks:** The species differs from *Tricolporopollenites baculoferus* in its size. Measuring diameter is 24- 26μm.

**Previously recorded occurence:** From the Lower Eocene to Upper Eocene of Hungary (Kedves, 1963).

*Tricolporopollenites porasper* PF. *in* TH. & PF. 1953

Plate IX; figure 25

**Previously recorded occurence:** Kedves (1963) mentions occurences of the species in the Lower and Upper Eocene of Hungary. According to Nakoman (1966a) the species are present in the Tertiary of the Thrace Basin (Turkey). Akgün & Sözbilir (2000) mention occurences in the Upper Oligocene sediments of SW Anatolian Molasse basin.

*Tricolporopollenites microreticulatus* PF. & TH. *in* TH. & PF. 1953
Plate IX; figures 26 – 29

**Previously recorded occurence:** Thomson & Pflug (1953) record the species from the Paleocene to Pliocene of the Middle – East Europa.

*Tricolporopollenites iliacus* (R. POT. 1931d) TH. & PF. 1953
Plate IX; figure 30 – 32

**Previously recorded occurence**: Thomson & Pflug (1953) mentions occurences of the species from the Lower Eocene to recent of the Middle Europa.

*Tricolporopollenites margaritatus* (R. POT. 1931a) TH. & PF. 1953 f. *medius* PF. & TH.*in* TH. & PF. 1953
Plate IX; figures 33 – 35

**Previously recorded occurence**: Akyol (1971) recorded the species in the Lower Oligocene of Şile – İstanbul.

*Tricolporopollenites striatopunctatus* KRUTZSCH & VANHOORNE, 1977
Plate IX; figure 36

**Previously recorded occurence**: Chateauneuf (1980) suggested the species in the Upper Eocene of France.

**Genus:** *Mediocolpopollis* KRUTZSCH, 1959c

**Type Species:** *Mediocolpopollis compactus* KRUTZSCH, 1959c

*Mediocolpopollis compactus* KRUTZSCH, 1959c ssp. e*llenhaunensis* KRUTZSCH, 1970
Plate IX; figures 37 – 38

**Previously recorded occurrence:** Hochuli (1978) mentions occurences of the species from the Upper Eocene to Lower Oligocene of the Central and Western Paratethys. Nickel (1996) indicates the species in the Upper Eocene of the Upper Rhine Graben.

**Genus:** *Tetracolporopollenites* PF. & TH. *in* TH. & PF. 1953

**Type Species:** *Tetracolporopollenites sapatoides* PF. & TH. *in* TH. & PF. 1953

*Tetracolporopollenites obscrus* PF. & TH. *in* TH. & PF. 1953
Plate IX; figures 39 – 41

**Previously recorded occurrence**: According to Thomson & Pflug (1953) the species occurs in the Lower- Middle Tertiary of the Middle Europa.

*Tetracolporopollenites abditus* PF. *in* TH. & PF. 1953
Plate IX; figures 42 – 43

**Previously recorded occurrence:** Akyol (1980) reported the species in the Eocene of Bayat (Çorum- Turkey) and didn't appear after the Upper most of the Upper Oligocene. Akgün & Sözbilir (2000) records the species in the Upper Oligocene of SW Anatolian Molasse Basin.

**Genus:** *Tetradopollenites* PF. & TH. *in* TH. & PF. 1953

**Type species:** *Tetradopollenites ericius* (R. POT. 1931a) TH. & PF. 1953

*Tetradopollenites ericius* (R. POT. 1931a) TH. & PF. 1953
Plate X; figure 1

**Previously recorded occurrence:** From the Paleocene to Pliocene of the Middle Europa (Thomson & Pflug, 1953). According to Nakoman (1966a) the species may be present all the Tertiary of Thrace Basin.

**Genus:** *Periporopollenites* PF. & TH. *in* TH. & PF. 1953

**Type Species:** *Periporopollenites stigmosus* (R. POT. 1931) TH. & PF. 1953

*Periporopollenites stigmosus* (R. POT. 1931a) TH. & PF. 1953
Plate X; figures 2 – 3

**Previously recorded occurence:** Thomson & Pflug (1953) described the species in the Middle and Upper Oligocene sediments of the Middle Europa. Nakoman (1966a) indicates that the species occur all the Tertiary of Thrace Basin. Hochuli (1978) mentions occurences of the species from the Middle Oligocene to Pliocene of the Central and Western Paratethys. Chateauneuf (1980) recorded the species from the Upper most Middle Eocene to Upper Eocene of the Paris Basin (France). Kirchner (1984) reported the species from the Eocene to Pliocene of the Southern Bavarian.

*Periporopollenites* sp.
Plate X; figures 4 – 5

**Remarks:** The genus of *Periporopollenites* couldn't be determined because of a lack of well protection.

*Periporopollenites* sp. (Thallictrum type)

Plate X; figures 6-8

**Remarks:** The species is indicated as a Thallictrum type pollen by Benda (1971). According to the author, the species is small. Surface ornemantation is from psilate to reticulate. Amp is oval or circular. It has numerous pores.

**Genus:** *Buxapollis* KRUTZSCH, 1966

**Type Species**: *Buxapollis buxoides* KRUTZSCH, 1966

*Buxapollis buxoides* KRUTZSCH, 1966

Plate X; figures 9 – 11

**Previously recorded occurence:** Krutzsch (1966) reported the species in the Upper Oligocene sediments of Germany. Gorin (1975) indicated the species in Grande Limagne (Massif Central).

### 3.3.3 Fungal Spores

**Genus:** *Diporicellaesporites* ELSIK, 1968

**Type species:** *Diporicellaesporites stacyi* ELSIK, 1968

*Diporicellaesporites stacyi* ELSIK, 1968

Plate X; figure 12

**Previously recorded occurrence:** Elsik (1968) mentions occurences of the species can be observed from the Campanian to recent.

**Genus:** *Anatolinites* ELSIK, EDIGER & BATI 1990

**Type Species:** *Anatolinites dongyingensis* (KE & SHI, 1978) ELSIK, EDIGER & BATI, 1990

*Anatolinites dongyingensis* (KE & SHI 1978) ELSIK, EDIGER & BATI, 1990
Plate X; figure 13 – 14

**Previously recorded occurrence:** Batı (1996) recorded the species from the Upper Oligocene of the Thrace Basin. Elsik et al. (1990) indicates that the species occur from the Upper Eocene to Lower Miocene of Thrace Basin.

**Genus:** *Multicellaesporites* ELSIK, 1968

**Type Species:** *Multicellaesporites nortonii* ELSIK, 1968

*Multicellaesporites* sp.
Plate X; figure 15

**Remarks:** Fungal spore spindle – shaped. Size 34 X 14 μm. Multicellate, middle cells much bigger than the terminal ones. Inaperturate, spore wall thick and laevigate.

**Genus:** *Pluricellaesporites* (VAN DER HAMMEN, 1954) SHEFFY & DILCHER, 1971

**Type Species:** *Pluricellaesporites typicus* VAN DER HAMMEN, 1954

*Pluricellaesporites* sp.
Plate X; figure 16

**Remarks:** Fungal spore straight and slightly curved. Length 94µm , width 16µm. Monoporate, Multicellate. Septa about 4µm thick. Transverse and longitudional septa over at least a portion of the spore.

### 3.3.4 Incertae Cedis

**Genus:** *Ovoidites* (R.POT. 1951) KRUTZSCH, 1959

**Type Species:** *Ovoidites ligneolus* (R. POT. 1931a) R. POT. 1951

*Ovoidites ligneolus* (R. POT. 1931a) R. POT.1951
Plate X; figures 17 – 18

**Previously recorded occurrence:** Akgün & Akyol (1987) reported the species in Miocene of Çıtak coals.

### 3.3.5 Dinoflagellates

**Genus:** *Spiniferites* (MANTELL, 1850) SARJEANT, 1970

**Type Species:** *Spiniferites ramosus* (EHRENBERG, 1838) LOEBLICH & LOEBLICH, 1966

*Spiniferites ramosus* (EHRENBERG, 1838) LOEBLICH & LOEBLICH, 1966
Plate X; figure 19

**Previously recorded occurrence**: Sarkar & Singh (1988) mention the occurences of the species from the Lower Cretaceous to recent sediments from the different parts of the world.

**Genus:** *Cordosphaeridium* (KLUMP, 1953) MORG. 1966

**Type Species:** *Cordosphaeridium inodes* (KLUMP, 1953) MORG.1966

*Cordosphaeridium inodes* (KLUMP, 1953) MORG. 1966
Plate X; figure 20

**Previously recorded occurrence**: Gruas - Cavagnetto (1968) reports the species from the Paleocene to Miocene of the Paris Basin.

Indetermine form
Plate X; figures 21 – 22

### 3.4 Quantitative and Qualitative Analysis of the Palynological Data

In this study, 135 palynologic samples taken from the Hayrettin and Tokça formations were examined. Only eight of these samples were counted. 16 spores, 5 gymnosperm non – saccate pollen, 6 gymnosperm saccate pollen, 75 angiosperm pollen, 2 fungal spores, 2 dinoflagellates and a incertae cedis species were indicated in our assemblage. Palynomorph diagram for the samples in the area depict relative abundance of these species (Table 3.1).

Hayrettin formation presents restricted sporomorph assemblage. However *Leiotriletes adriennis, Leiotriletes dorogensis, Echinatisporis* cf.*bockwitzensis, Pityosporites microalatus, Dicolpopollis kockelii, Triatriopollenites rurensis, Momipites punctatus, Subtriporopollenites simplex* ssp. *simplex, Intratriporopollenites instructus, Boehlensipollis hohli, Tricolpopollenites densus, Tricolpopollenites retiformis, Tricolporopollenies eschweilerensis,*

*Tricolporopollenites kruschi* and *Tricolporopollenites microreticulatus* are observed sporadically in the samples. Stratigraphically important species *Boehlensipollis hohli* and *Dicolpopollis kockelii* were also recorded in the Hayrettin formation.

In contrast to Hayrettin formation, Tokça formation contains abundant sporomorph assemblage and their percentages can be summarized as below

In this fomation, *Momipites punctatus* is present abundantly in the samples. It is represented on an average 17.5 % and observed almost in all samples. *Tricolporopollenites microreticulatus* is present abundantly in the samples. It has on an average 10.1%. *Pityosporites microalatus* is represented at high percentages. It reaches up to 35 % in some samples and is present almost in all samples.

Although *Leiotriletes dorogensis* and *Leiotriletes adriennis* haven't observed in each samples, the abundance of the species reaches up to 10 % in a samples. In some samples *Baculatisporites primarius* ssp. *crassiprimarius* reaches up to 14 % and *Baculatisporites primarius* ssp.*oligocaenicus* 18 %. *Laevigatosporites haardti* is represented abundantly in the samples. It reaches up to 32 % in the samples.

*Sparganiaceaepollenites* reaches up to 40 % in some samples. It is present on an average % 10.8. *Triatriopollenites coryphaeus* reaches up to 25 % in some samples. *Subtriporopollenites simplex* reaches up to 15 % in some samples. It is generally presents between 3 % and 5 % in all samples. *Tricolpopollenites microhenrici* has percentages between 1 % and 16 %. *Tricolporopollenites cingulum* is observed in all samples regularly and has percentages between 1 % and 5 %. *Tricolporopollenites megaexactus* is present almost an all samples and has percentages of 1 % and 8 %.

The species *Verrucatosporites alienus, Verrucatosporites histiopterpides* ssp. *histiopteroides, Verrucatosporites favus*, *Leiotriletes microadriennis, Echinatisporis longechinus* is present sporadically in the samples of Tokça formation.

Stratigraphically important species such as *Aglaoeridia cyclops*, *Dicolpopollis kockelii, Slowakipollis hipophäeoides, Pentapollenites pentangulus, Compositoipollenites rhizophorus* ssp. *burghasungensis, Mediocolpopollis* *compactus* ssp. *ellehaunensis* are present sporadically in the samples. However, the species *Dicolpopollis kockelii* reaches up to 15 % in the only one sample.

Additionally, the species *Boehlensipollis hohli, Slowakipollis hipophäeoides, Mediocolpopollis compactus* ssp. *ellehaunensis, Spinozonocolpites echinatus, Spinozonocolpites* sp., *Longapertites* sp., *Myrtaceidites mesonesus, Cupaniëidites eucalyptoides, Olaxipollis matthesii,* and *Buxapollis buxoides* which haven't been mentioned in Turkish Tertiary up to now are recorded in this study.

### 3.5 Palynostratigraphy

Counting results show that abundantly occuring species is not important stratigraphically. However few species observed very little in counting are quite important determining the age

Hayrettin and Tokça assemblages lack species of characteristic Eocene forms such as *Microfaveolatosporites pseudodentatus, Cicatricosisporites pseudodorogensis* and *Punctatosporites paleogenicus*. However in our sporomorh assemblage includes stratigraphically important species such as *Boehlensipollis hohli, Slowakipollis hipophäeoides, Aglaoeridia cyclops, Dicolpopollis kockelii, Compositoipollenites rhizophorus* ssp. *burghasungensis, Mediocolpopollis compactus* ssp. *ellenhaunensis* and *Pentapollenites pentangulus* (Fig.3. 1).

*Boehlensipollis hohli* is the most indicative pollen of the age of these assemblages. The species is a stratigraphic marker of the Lower- Middle Oligocene of France (Chateauneuf, 1980; Gorin, 1975; Pierre,1993). Moreover Hochuli (1978) indicates from the Lower-Middle Oligocene of the Central and Western Paratethys.

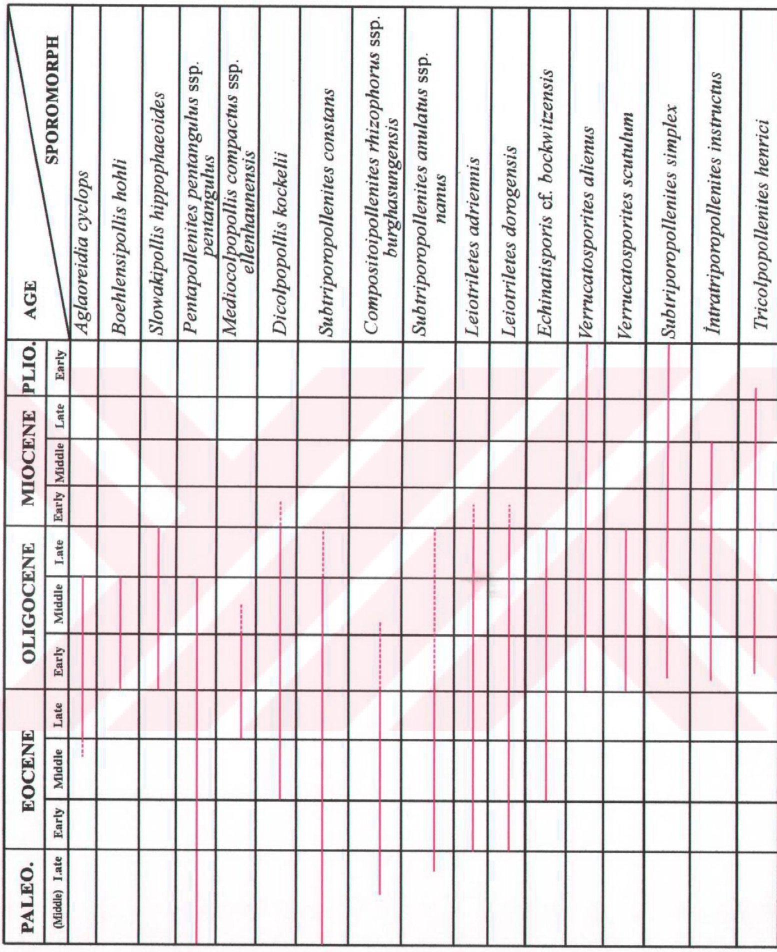


Figure 3.1 List of the Stratigraphically Important Sporomorphs

In the Belgium Roche in Vinken (1988) and in the Netherlands Schalke in Vinken (1988) indicate the species from the Middle Oligocene in age.

*Slowakipollis hipophäeoides* is an important form for the Oligocene. According to Gorin (1975) the species is characteristic form from the Middle Oligocene of Grande Limagne (France). It occurs in the Lower - Middle Oligocene of the Paris Basin (Chateauneuf, 1980). Hochuli (1978) also mentions occurences of the species from the Lower- Middle Oligocene of the Central and Western Paratethys.

*Aglaoeridia cyclops* demonstrates a stratigraphic range in the Middle Oligocene. The species appears lately in the Middle Oligocene. From this viewpoint the species terminated at the end of the Middle Oligocene. Nickel (1996) recorded the species from the Middle Eocene to Middle Oligocene of the Rhine Graben. Chateauneuf (1980)shows the species from the Late Eocene to Middle Oligocene of the Paris Basin. In addition Hochuli (1978) suggests the species from the Lower – Middle Oligocene of the Central and Western Paratethys.

*Dicolpopollis kockelii* is generally occured in Oligocene sediments. According to Nakoman (1966a) the species occur in the Lower Tertiary sediments of the Thrace Basin. Akyol (1971) indicates the species from the Lower Oligocene of Şile-İstanbul. According to the Wilkison et al. (1980) the species although not restricted in the Oligocene ,occur such regularity only in NW European Oligocene deposits. Ediger et al. (1990) reported that, although form genus *Dicolpopollis* is frequently found in the Eocene – Oligocene rocks all over the world, *Dicolpopollis kockelii* forms an acme zone in the Upper Oligocene (Chattian) rocks in the Northern Thrace Basin. Batı (1996) studied the Thrace Basin. The author recorded the species very frequently in Upper Oligocene sediments of Thrace Basin. Akgün & Sözbilir (2000) show it from the Upper Oligocene of SW Anatolian Molasse Basin.

*Compositoiopollenites rhizophorus* ssp. *burghasungensis* subspecies reaches to the Upper Eocene and disappears after this age in Europa (Thomson &Pflug, 1953; Gruas – Cavagnetto, 1968; Kedves,1970; Nickel, 1996). However, Nakoman (1996a) recorded *Intratriporopollenites rhizophorus.* The author indicates that this species is the Lower Tertiary age. *Compositoiopollenites rhizophorus* ssp. *burghasungensis* subspecies is also observed in our Lower – Middle Oligocene assemblage.

Another stratigraphically important form is *Mediocolpopollis compactus* ssp. *ellenhaunensis*. According to Nickel (1996) the species is characterized from the Upper Eocene of the Rhine graben. Hochuli (1978) shows the species which exists from the Upper Eocene to Middle Oligocene of the Central and Western Paratethys.

As mentioned above for *Aglaoeridia cyclops*, *Pentapollenites pentangulus* is not observed till the end of the Middle Oligocene. According to Chateauneuf (1980) the species is characterized in the Middle Oligocene of the Paris Basin. Nickel (1996) shows that the species is from the Paleocene to Middle Oligocene of the Rhine Graben.

Moreover the species of *Subtriporopollenites simplex* and *Intratriporopollenites instructus* appear firstly in Lower Oligocene and their existence continue up to the Miocene. Hochuli (1978), Cavagnetto in Vinken (1988), Schuler in Vinken (1988), Roche in Vinken (1988) and Nickel (1996) suggest the species from the Lower Oligocene to Miocene. Chateauneuf (1980) shows the species from the Lower Oligocene to Middle Oligocene of the Paris Basin. The similar situation is valid for *İntratriporopollenites instructus.* The species is present from the Lower Oligocene to Miocene of Europa (Wilkinson & Boulter, 1980).

Eight forms were discussed stratigraphically above . Four of these which are *Boehlensipollis hohli, Aglaoeridia cyclops, Pentapollenites pentangulus* and *Mediocolpopollis compactus* ssp. *ellenhaunensis* disappear at the top of the Middle Oligocene. *Subtriporopollenites simplex* and *Intratriporopollenites instructus* appear in the Lower Oligocene.

Out of the species and subspecies mentioned above, *Leiotriletes microadriennis, Leiotriletes dorogensis, Leiotriletes adriennis, Verrucatosporites scutulum,* *Verrucatosporites alienus* , *Verrucatosporites favus* found in the Eocene – Oligocene are observed abundantly in some of our samples.

Based on the avaliable evidence, it is reasonable to conclude that Hayrettin and Tokça formations can be dated in the Lower-Middle Oligocene in age.

### 3.6 Correlation of the Sphoromorph Assemblage from Turkey and Outside

Palynological studies on Turkish Oligocene were concentrated in the Thrace Basin. But the other parts of Turkey comprise restricted Oligocene sediments. The Tokça and Hayrettin formations comprise coal layers. The Hayrettin coals are not economical. The Tokça coals is worked by the seven coal mines. The Tokça coals haven't studied efficiently in detail up till now.

Nakoman (1968) investigated the sporomorph assemblage of the Ağaçlı (İstanbul) lignites.The author mentions that the species of *Subtriporopollenites* appear in the Lower Oligocene. *Inaperturopollenites hiatus* appear first in the Middle Oligocene.The species *Monocolpopollenites tranquillus*, *Monoporopollenites areolatus*, *Triatriopollenites rurobituitus*, and *Porocolpopollenites vestibulum* are last appeared in the Middle Miocene age. According to the data mentioned above the author gives of the Ağaçlı (İstanbul) lignites as the Upper Oligocene or Lower Miocene. The species *Subtriporopollenites* simplex is observed abundantly in our sporomorph assemblage.

The Tokça sphoromorph assemblage demonstrated first by Benda (1971) and his sporomorph assemblage was shown in his chart (Table 1 of Benda, 1971). This table includes 43 spore pollen taxa. *Leiotriletes adriennis, Verrucatosporites alienus Inaperturopollenites incertus, Arecipites triangulus, Triatriopollenites exelsus, Tricolporopollenite,cingulum, Tricolporopollenites pseudocingulum, Tricolpopollenites cingulum, Tricolporopollenites megaexactus, Tricolpopollenites* *liblarensis fallax* group, *Inaperturopollenites hiatus* occur frequently in his assemblage. *Microcoryphaeus punctatus* group, *myricoides, bituitus, rurensis* group, *Tricolporopollenites microreticulatus, Inaperturopollenites emmaensis, Tricolpopollenites microhenrici, Inaperturopollenites magnus* , *dubius* group, *Pinus haploxylon* group and *Polyvestibulopollenites verus* occur very frequently in this assemblage.

Benda (1971) mentions that the Tokça assemblage belongs to the Lower – Middle Oligocene. Our sphoromorph assemblage is similar to the Benda's spore pollen taxa. *Tricolporopollenites micoreticulatus, Tricolporopollenites cingulum, Tricolporopollenites megaexactus, Pityosporites microalatus and Tricolpopollenites microhenrici*, occur very frequently in our study. However *Dicolpopollis kockelii,* Aglaoeridia *cyclops, Slowakipollis hippophäeoides, Myrtaceidites mesonesus, Cupaniëidites eucalyptoides, Pentapollenites pentangulus, Retitriletes fragilis, Longatertites* sp. and *Olaxipollis matthesii* are totally absent in Benda's Tokça sporomorph assemblage. Although *Triatriopollenites excelsus* is present frequently in the Lower-Middle Oligocene of Benda's Tokça assemblage, the species haven't appeared in our samples. The age of the Tokça assemblage in our study is the same age with Benda's study. But the author didn't find any characteristic form for the Lower – Middle Oligocene such as *Aglaoeridia cyclops, Pentapollenites pentangulus, Medicolpopollis compactus ellenhaunensis* and *Dicolpopollis kockelii.*

Akyol (1971) studied the sporomorph assemblages of Şile – İstanbul. The author recorded 42 spore pollen taxa of which 27 are present in our samples. The most common taxa are *Laevigatosporites haardti* (1-5 %), *Verrucatosporites favus* ( 1-10 %), *Leiotriletes dorogensis* (1-5 %), *Pityosporites microalatus* (2-25 %), *Triatriopollenites rurensis* (1-25 %), *Triatripollenites coryphaeus* (6-50 %), *Dicolpopollis kockelii* (2-50 %), *Tricolpopollenites microhenrici* (0-5 %), *Tricolpopollenites liblarensis* (1-10 %), *Tricolporopollenites microreticulatus* (2-10 %) and *Extratriporopollenites pompejki* (<1-5 %). Due to sporomorph assemblage and *Extratriporopollenites pompejki* which reaches up to the Lower Oligocene, the author interpreted that the age of the Şile – İstanbul coals is the Lower Oligocene.

Laevigatosporites *haardti, Tricolporopollenites microreticulatus, Tricolporopollenites cingulum* and *Pityosporites microalatus,* have similar frequencies in Şile and our samples. But *Subtriporopollenites simplex* have a higher frequencies and *Dicolpopollis kockelii* have a lower frequencies in our samples. But the species *Boehlensipollis hohli, Slowakipollis hipophäeoides, Aglaoeridia cyclops* and *Pentapollenites pentangulus* don't appear in Şile samples. Similarity between sporomorph assemblages identified by Akyol (1971) and our study supports the Lower – Middle Oligocene age of our sporomorph assemblage.

Akgün & Sözbilir (2000) studied the SW Anatolian Molasse Basin (Denizli and Kale – Tavas Molasse). The Kale – Tavas Molasse basin consist of three regions which are namely Yemişendere, Kale and Tavas. The authors recorded a total of 34 genera and 63 species in these basins.

The authors distinguished two different sporomorph assemblages. The first sporomorph assemblage is present in the Denizli – Sağdere, Kale – Mortuma, Tavas – Mortuma, Yemişendere – Mortuma formations. The second assemblage is demonstrated as a Kale – Yenidere formation.

The age of the first assemblage is indicated as an Upper Oligocene (Chattian) by the authors due to the high percentage of *Dicolpopollis kockelii, Leiotriletes microadriennis* and *Leiotriletes adriennis*, rare existance of *Leiotriletes dorogensis, Verrucatosporites, Polypodiaceoisporites,* and *Monocolpopolllenites* species and sporadically occurrence of *Inaperturopollenites emmaensis, Subtriporopollenites intraconstans, Echinatisporis* cf. *bockwitzensis* and *Undulatusporites concavus.* The second sporomorph assemblage which includes sporadically is *Dicolpopollis kockelii* and abudance of the other Neogene species was indicated the Lower Miocene (Aquitanian). Our sporomorph assemblage comprises similar species.But some of the specific species such as *Boehlensipollis hohli, Aglaoeridia cyclops, Pentapollenites pentangulus* haven't observed up to the Middle Oligocene (Gorin , 1975; Hochuli, 1978; Chateauneuf , 1980; Nickel, 1996).

The Oligocene age of the Marseilles basin was examined by Chateauneuf (1969). The author distinguished four zones. The author placed these zones in the Upper Stampian. Gymnosperms are at higher percentages than the Angiosperms. The Gymnosperms population generally consist of the conifers. *Diploxlyon* type *Pinus* is in zone 4 (Upper Oligocene). zone 1 (Upper Eocene) comprises the *Haploxylon* type *Pinus*. Between zone 1 (Upper Eocene) and zone 3 (Lower – Middle Oligocene) *Abies, Tsuga* and *Picea* are observed. *Abies* appears sporadically. Finally in zone 2 (Lower Oligocene) and zone 3 (Lower – Middle Oligocene) which comprise Cupressaceae and Taxodiaceae are more important than the other zones. According to the author *Slowakipollis hipophäeoides* is present in all of the zones.The species of the *Boehlensipollis hohli* which haven't observed almost above the zone 2 (Lower Oligocene) is low frequencies in the samples. Our sporomorph assemblage consists of similar characteristic species with Chateauneuf's results such as *Boehlensipollis hohli* and *Slowakipollis hipophäeoides*. In addition to this, the abundance of the *Pityosporites microalatus* pollen that includes Chateauneuf (1969)'s abundant sporomorph assemblage is also observed in our sporomorph assemblage.

Schuler & Sittler (1969) studied sporomorph assemblage of two boreholes in the Oligo – Miocene of Forez Plain (Montbrison Basin, Central France ).Seven palynologic associations were set out by the authors. A total of the 32 spore pollen taxa were distinguished. *Leiotriletes adriennis*, *Leiotriletes microadriennis*, *Trilites solidus*, *Cicatricosisporites costatus, Baculatisporites primarius*, *Verrucatosporites favus* and *Laevigatosporites haardti* are the most abundant spore taxa. The most abundant pollen taxa are characterized by *Pityosporites microalatus*, *Inaperturopollenites hiatus*, *Inaperturopollenites dubius, Monocolpopollenites* tranquillus, *Subtriporopollenites simplex*, *Sparganiaceaepollenites sparganioides*, *Triatriopollenites coyphaeus*, *Corsinipollenites oculis noctis*, *Polyvestibukopollenites verus, Tricolpopollenites microhenrici* and *Tricolpopollenites retiformis*. The authors indicate the Upper Oligocene to Lower Miocene age on an account of the sporomorph assemblage explained above. The sporomorph assemblage may not correlate our with sporomorph assemblage which includes different species. But Schuler & Sittler (1969)'s sporomorph assemblage dont have any characteristic

Lower – Middle Oligocene species such as *Boehlensipollis hohli, Aglaoeridia cyclops Pentapollenites pentangulus, Compositoipollenites rhizophorus* ssp. *burghasungensis* (Gorin, 1975; Nickel, 1996).

Gorin (1975) examined the sporomorph assemblage of Grande Limagne ( Massif Central, France).The author distinguished the six palynostratigraphic zones. The spores including Eocene species which are *Cicatricosisporites dorogensis, Echinatisporis verruechinus, Toripunctisporis lusaticus, Concavisporites acutus, Echinatisporis* cf. *bockwitzensis* and *Polypodiaceoisporites zengövarkonyensis* are in very low frequencies.

According to the author *Boehlensipollis* is the most important genus of the Oligocene of Grande Limagne (Massif Central, France). The existence of the *Boehlensipollis* indicates zone III (Lower – Middle Oligocene age). If the *Boehlensipollis* disappears in a level, the species *Slowakipollis* can appear in this level. In that case the level points out zone IV (Upper Oligocene). If both *Boehlensipollis* and *Slowakipollis* appear in a level and then it absolutely indicates zone III (Lower – Middle Oligocene). According to the author if the species *Boehlensipollis* and *Slowakipollis* disappear, there are two probablities. a) Existence of old species. In this case these species indicates the Upper Eocene or Sannoisian (the Lowest part of the Oligocene). b) Absence of old species and then it demostrates the Upper Oligocene (Chattian) age.

According to the author *Plicapollis pseudoexelcus,* that is a Normapolle, located in zone I (Upper Eocene) abundantly.The species may be present in the lower part of the Stampien but the species disappears rapidly up to the Stampian. If *Plicapollis pseudoexelsus* appears in a level, the species points out in zone I (Upper Eocene) or zone II (Lower Oligocene ). The species *Plicapollis pseudoexelcus* can be present with *Boehlensipollis hohli* in zone II (Lower Oligocene).

The similarity between this study and our study are noticeable. Especially *Boehlensipollis* and *Slowakipollis* are the most important species of Grande Limagne and the species occur in our assemblage.

Boulter& Craig (1979) examined the Stanley Bank Basin of the Bristol Channel which comprises three boreholes. The authors have identified 49 genera. Some of the spores which are namely *Leiotriletes*, *Laevigatosporites*, *and Baculatisporites* are abundant in their samples and the pollen of *Inaperturopollenites, Pityosporites*, *Arecipites*, *Cycadopites*, *Nyssapollenites*, *Tricolpopollenites*, *Tricolporopollenites, Tiliaepollenites* and *Polyvestibulopollenites* also occur abundantly in the samples. According to the authors five genera which are *Monocolpopollenites, Arecipites, Boehlensipollis, Dicolpopollis* and *Gothanipollis* occur together consistently. The age of the Stanley Bank Basin is indicated as the Middle Oligocene by the authors. Our sporomorph assemblage resembles Boulter & Craig (1979)'s sporomorph assemblage except *Gothanipollis*, *Arecipites* and *Monocolpopollenites*. In addition to the taxa mentioned above *Pentapollenites*, *Myrtaceidites*, *Slowakipollis*, *Olaxipollis, Aglaoeridia* and *Spinozonocolpites* occur in our study.

Wilkinson & Boulter (1980) examined the sporomorph assemblage of the Western part of the British Isles.They recorded 76 previously established genera and 142 subgeneric groups. According to the authors the species of *Trilites*, *Cicatricosisporites*, *Camarozonosporites*, *Verrucingulatisporites, Muerrigerisporis*, *Echinosporis*, *Corrusporis*, *Arecipites*, *Dicolpopollis*, *Tiliaepollenites*, *Nyssapollenites*, *Mediocolpopollis*, *Porocolpopollenites*, *Tricolporopollenites*, *Polyatriopollenites* and *Boehlensipollis* were restricted in the Oligocene sediments. The authors suggest that the age of the assemblage is the Middle – Upper Oligocene. Our assemblage haven't comprised the species *Cicatricosisporites*, *Camarozonosporites*, *Echinosporis*, *Verrucingulatisporis*, *Muerrigerisporis*, *Corrusporis*, *Arecipites*, and *Polyatriopollenites*. The similarity between the sporomorph assemblage identified by Wilkinson & Boulter (1980) and in our assemblage support the reliability of the Lower – Middle Oligocene age determination. Especially the species *Boehlensipollis hohli,* *Dicolpopollis kockelii*, *Pentapollenites pentangulus*, *Aglaoeridia cyclops*, *Subtriporopollenites simplex*, *Intratriporopollenites instructus*, *Leiotriletes dorogensis*, *Mediocolpopollis compactus ellenhaunensis*, *Verrucatosporites scutulum* and *Slowakipollis hipophäeoides* are the most important species in our study for the Lower – Middle Oligocene age.

Wilkinson et. al. (1980) examined the sporomorph assemblage of the Lough Neagh Clays (Northern Ireland). The most common flora comprises the species *Polypodiaceoisporites, Inaperturopollenites, Pityosporites, Monocolpopollenites Tricolpopollenites, Tricolporopollenites, Nyssapolllenites, Momipites* and *Polyvestibulopollenites.* Furthermore *Dicolpopollis, Boehlensipollis* and *Mediocolpopollis* were found by the authors. They mention that the Lough Neagh clays are a Chattian age. Although the sporomorph assemblage identified in the Lough Neagh Clays give a Upper Oligocene age,the sporomorph assemblage is quite similar to our assemblage. Especially *Boehlensipollis, Dicolpopollis,* and *Mediocolpopollis* which are characterized by the Oligocene are present in our study. The authors mention that *Boehlensipollis hohli* were restricted in the Oligocene sediments. Data mentioned above supports that our assemblage assigns the Lower – Middle Oligocene age.

Kirchner (1984) studied the sporomorph assemblage of the Upper Oligocene of the Southern Bavarian coals. The author recorded 93 sporomorph: 18 are spores and 75 pollen.The assemblage comprises some spores which are *Retitriletes*, *Leiotriletes*, *Stereisporites*, *Baculatisporites*, *Polypodiaceoisporites*, *Verrucatosporites*, *Laevigatosporites* and *Pustechinosporis* and some pollen which are *Piceapollis*, *Pityosporites*, *Zonalapollenites*, *Podocarpitides*, *Inaperturopollenites*, *Sequoiapollenites*, *Cyperacepollis*, Arecipites, Monogemmites, *Dicolpopollis*, *Triatriopollenites*, *Momipites*, *Platycaryapollenites*, *Polyporopollenites*, and *Slowakipollis*. The author suggests that the age of the Southern Bavarian coals is the Upper Oligocene. Though the Upper Oligocene is not similar to our sporomorph assemblage, some of the spores and pollen are absent in our study such as *Pustechinosporis*, *Stereisporites*, *Zonolapollenites*, *Cyperacepollis*, *Arecipites* and

*Platycaryapollenites*. Our sporomorph assemblage indicates the Lower – Middle Oligocene age in having *Leiotriletes dorogensis*, , *Leiotriletes microadriennis, Leiotriletes adriennis, Verrucatosporites scutulum, Aglaoeridia cyclops, Boehlensipollis hohli, Pentapollenites pentangulus Compositoipollenites rhizophorus* ssp, *burghasungensis, Slowakipollis hipophäeoides* and *Dicolpollis kockelii*.

Gruas – Cavagnetto & Barbin (1989) studied the Priabonian type section (Vincetin,Northern Italy). The author represented 53 families. Of these, 9 are Pteridophyts and 39 are Angiosperms. According to the author the Priabonian stage at this type locality contains very rich flora. The Priabonian of the North Italy generally consists of ornamented tricolporate species which are Araliaceae (*Scabtricolporites araliaceoides, Scabratricolporites scheffleroides,* and *Scabratricolporites doubingerae*), Theaceae (*Scabratricolporites magnotectatus, Scabratricolporites theaceoides* and *Scabratricolporites irregularis*) and incertae cedis (*Scabratricolporites cylindricus*). These taxon which especially includes Araliaceae (*Scabratricolporites*) arise frequently in the Lower Oligocene sediment indicating the lagoon facies. According to the author if these species located freguently in the Upper Eocene sediments, some of the species could appear in the Middle Eocene. The author recorded the *Boehlensipollis hohli* characterizing the Lower – Middle Oligocene. Though the author mentioned that the species occurs in the Lower – Middle Oligocene of the Western Europa, it is observed the in the Upper most Eocene. *Boehlensipollis hohli* occurs in our sporomorph assemblage except common ornamented tricolporate pollen. However, in our study new species was indicated which name is *Tricolpopollenites akgünii* having coarse ornaments.

Ollivier – Pierre et. al. (1993) studied sporomorph assemblage of the Middle Oligocene age of the Bretagne coals (France). The authors demonstrate the sporomorph assemblage which is rich and uniform. Various numbers of sporomorphs belong to the different species. Pollen which belong to Pinaceae of the disaccates is always rich. Monocotyledons such as Restionaceae and Sparganiaceae are observed regularly but they have got different percentages variables. Angiosperms which are Fagaceae, Ulmaceae, Betulaceae, Thymelaceae, Cyrillaceae, Ebenaceae, Oleaceae, Theaceae, Euphorbiaceae, Araliaceae, Sapotaceae, Aquifoliaceae, Rubiaceae, Ericaceae and Eleagnaceae are observed sporadically.

According to the author *Boehlensipollis hohli*, *Aglaoeridia* cyclops and *Dicolpopollis kockelii* are the most important species in respect to the stratigraphy. The author indicates that mentioned assemblage characterizes the Upper Rupelian age.The close similarity between the sporomorph assemblage was identified by Oliver – Pierre et. al. (1993) and that of our sporomorph assemblage also indicates the Lower – Middle Oligocene age.

### 3.7 Paleoclimatology and Paleoecology

In this part, paleoclimatic variations were indicated and paleoecological interpretations were demonstrated. The Lower – Middle Oligocene sphoromorph floras of the Hayrettin and Tokça formations indicate a subtropical climate.

Wolfe & Hopkins (1967) determinated that in the Western North America, a warming trend lasted from the Middle Eocene through the Upper Eocene, reaching a maximum during the Upper most Eocene to the Lower part of the Oligocene (fig 3.2).

Hornibrook (1967) mentions that the climate cools through the end of the Eocene (fig.3.2). According to Wolfe (1971) a major and rapid climatic deterioration occured in the Oligocene and a major climatic fluctuation probably occured in the Late Eocene.

Elsik (1974) concluded that the climatic shifts in the Gulf Coast were from warmer in the Middle Eocene, cooler in the Upper Eocene to still cooler in the Oligocene, and that last climatic change took place at the very and of the Eocene or Lower Oligocene.

Gorin (1975) studied the Grande Limagne ( Massif Central, France). According to the author the climate in the Upper Eocene was humid and tropical and starts to cool thorough the Oligocene. Cooling can be cut with high temperature wavings.

Another important research was made by Hochuli (1978). He reported that floral elements are climatic indicators and quantitative evaluation of them permits the characterization of the climate during the geologic history. For this purpose, he classified the floral elements into three elements as Thermophilus, Arcto Tertiary and Intermediate and then plotted relative frequencies of these floral elements through the Upper Eocene – Lower Miocene. As it clearly seen on his plot (page 42) thermophile elements indicate a maximum occurence (!00 %) in the Upper Eocene and reduce through the Upper Oligocene. However the Arcto Tertiary and Intermediate elements rise slowly to the Upper Oligocene.

Chateauneuf (1969) studied the Marseilles Basin. The author indicates that Tertiary Thermophil species is low frequencies relative to the Arctic Tertiary species.

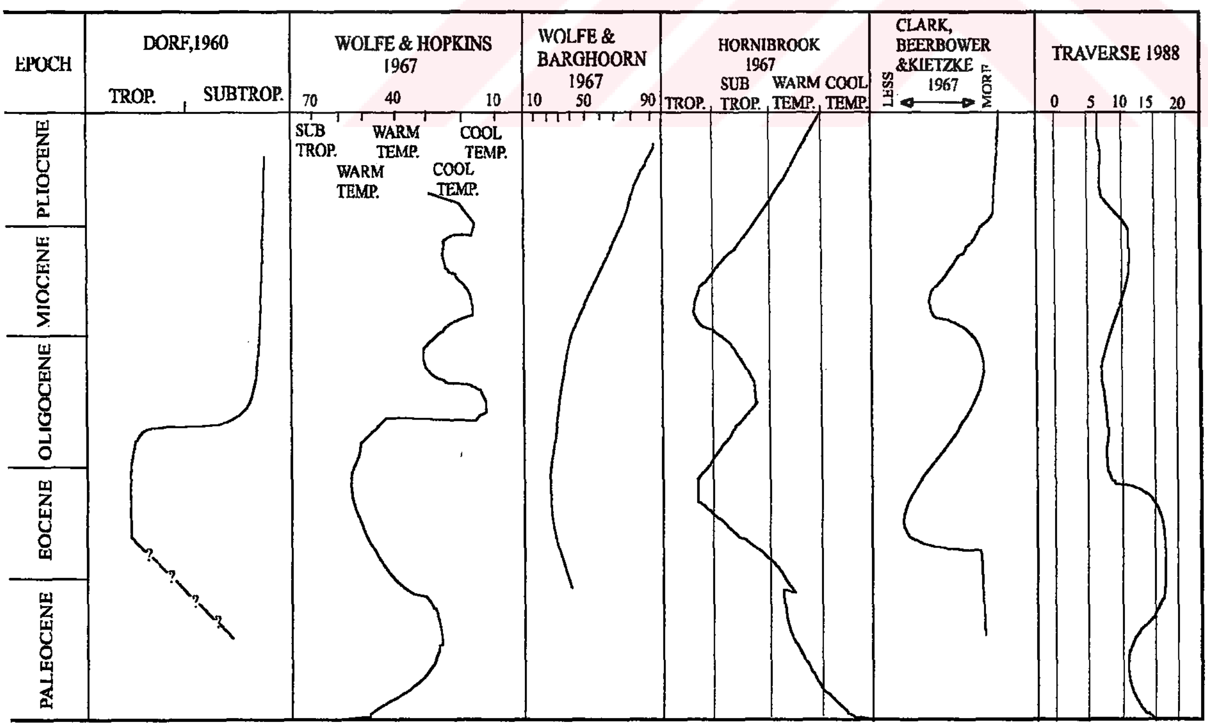


Figure 3.2 Correlation of Paleoclimatic Variations

According to the author the climate unchanged in his four zones unexpectedly. While the climate was hot and dry in zone 1 (Upper Eocene) and zone2 (Lower Oligocene), it was cool and humid through zone 3 ( Lower – Middle Oligocene) and zone 4 (Upper Oligocene).

The Hayrettin formation includes poor assemblages with regard to its diversity. The fossil record can't found except *Tilia* (*Intratriporopollenites instructus*), Schizaeceae (*Leiotriletes dorogensis*), *Nypa* (*Spinozonocolpites* sp., *Spinozocolpites echinatus*) and Elaegnaceae (*Boehlensipollis hohli*). The rhizomatic palm *Nypa* (*Spinozonocolpites*) is an ecologic marker of true mangrove vegetation. It demonstrates brakish water to marine coastal enviroment.

The Tokça formation consists of numerous sphoromorphs in order to the Hayrettin formation. Pteridophytic remains represented by the spores Osmundaceae (*Baculatisporites*), Schizaeceae (*Leiotriletes, Triletes*), Polypodiaceae (*Polypodiaceoisporites, Laevigatosporites,* and *Verrucatosporites*), Selaginellaceae (*Echinatisporis, Lusatisporis*) and Lycopodiaceae (*Retitriletes*) provide important ground cover and indicate perennial water and warm humid climate.

The common occurences of conifer pollen *Pinus* (*Pityosporites*), Fagaceae (*Tricolporopollenites microhenrici*) and *Castane* (*Tricolporopollenites cingulum*) are generally interpreted as coming from more upland region.The most population of this flora is represented by the eight families of Angiosperms which are namely Cyacadaceae (*Cycadopites*), Oleaceae (*Tricolporopollenites microreticulatus*), Juglandaceae (*Momipites punctatus*), Sparganiaceae (*Sparganiaceaepollenites*) *Carya* (*Subtriporopollenites simlex*), *Castanae* (*Tricolporopollenites cingulum*), Cyrillaceae (*Tricolporopollenites megaexactus*) and Fagaceae (*Tricolporopollenites microhenrici*). Of these, monocotys are documented by the two families. Sparganiaceae (*Sparganiaceaepollenites*) is certain indicator of fresh water aquatic habitat. *Aglaoeridia cyclops* accompanies with Sparganiaceae (*Sparganiaceaepollenite*). Cycadaceae (*Cycadopites*) is a lower lying shrubland plant.

The most dominant population of the lowland subtropical flora is witnessed by the pollen Juglandaceae (*Momipites punctatus*) , Cyrillaceae (*Tricolporopollenites megaexactus*) and *Carya* (*Subtriporopollenites simplex*).

# CHAPTER FOUR
# CONCLUSIONS

Detail palynological investigations in the Hayrettin and Tokça formations lead us to following conclusions.

1- In our study, totally four measured type section, 48 coal, lignites and mudstones samples were taken from the Hayrettin and Tokça formations. A total of 55 genera and 104 species were indicated in the study. The Tokça formation has a rich microflora. However poor assemblage characterizes the Hayrettin formation. In the Hayrettin formation, there is no microfossil record except *Leiotriletes adriennis, Leiotriletes dorogensis, Echinatisporis* cf. *bockwitzensis, Dicolpopollis kockelii, Triatriopollenites rurensis, Momipites punctatus, Subtriporopollenites simplex, Intratriporopollenites instructus, Boehlensipollis hohli, Tricolpopollenites densus, Spinozonocolpites echinatus* , *Sipinozonocolpites* sp. *Tricolporopollenites retiformis Tricolporopollenites eschweilerensis, Tricolporopollenites kruschi* and *Tricolporopollenites porasper*. The age of the Hayrettin and Tokça formations is considered as the Lower – Middle Oligocene.

2- Stratigraphically important species *Boehlensipollis hohli, Slowakipollis hipophäeoides, Pentapollenites pentangulus, Aglaoeridia cyclops, Dicolpopollis kockeli, Mediocolpopollis compactus* ssp. *ellenhaunensis* were recorded in the study.

3- The species *Boehlensipollis hohli*, *Slowakipollis hipophäeoides*, *Mediocolpopollis compactus* ssp. *ellenhaunensis*, *Myrtaceidites mesonesus*, *Cupaniëidites eucalyptoides*, *Spinozonocolpites echinatus*, *Spinozonocolpites* sp., *Pentapollenites pentangulus*, *Olaxipollis matthesi*, *Aglaoeridia cyclops*, were indicated firstly in our study for Turkish Tertiary.

4- The new species *Tricolpopollenites akgünii* was described in this study.

5- The subtropical climate is considered based on spore – pollen remainings for the Hayrettin and Tokça formations. Especially *Pinus* and *Querqus* indicate existing in the upland flora.

6- The assemblage of spore – pollen taxa from the Hayrettin formation are preserved sedimentation near deltaic condition because the *Nypa* (*Spinozonocolpites*) suggests brakich water to marine coastal enviroment. The Tokça formation was deposited in lakes and flood plains. The region was supported in dense lowland and upland vegetation.

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## APPENDIX: Explanation of the Plates

All the photograps are figured at a magnification of x 500.

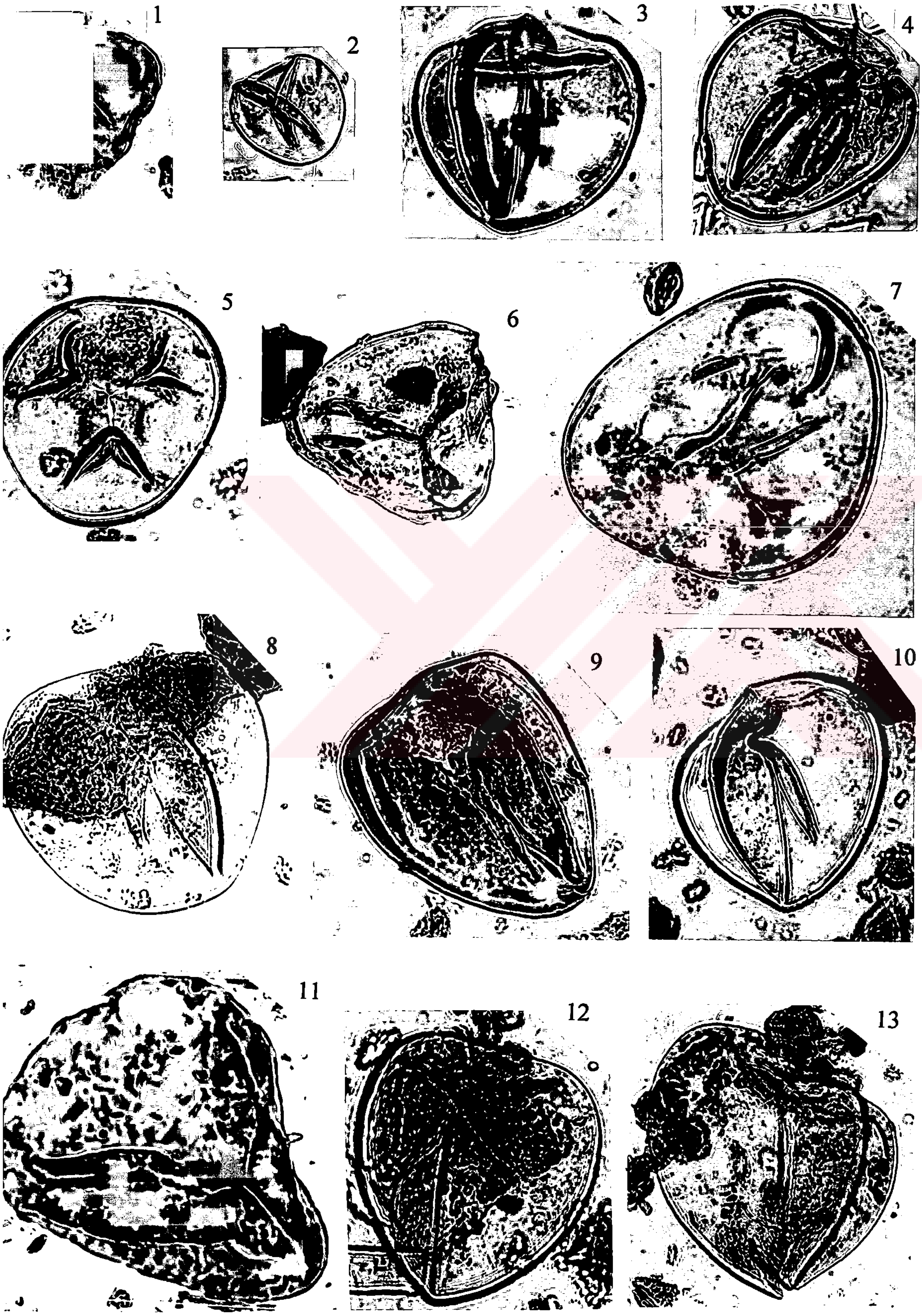
### PLATE I

**Figs. 1 – 2.** *Leiotriletes microadriennis* KRUTZSCH; **Fig.1.** Slide no: Tç – 6c
**Fig. 2.** Slide no: Tç – 6f

**Figs. 3 – 6.** *Leiotriletes adriennis* (R. POT. & GELLETICH) KRUTZSCH;
**Fig. 3.** Slide no: Tç – 6e;**Fig. 4.** Slide no: Tç – 6a; **Fig. 5.** Slide no: Tç – b; **Fig. 6.** Slide no: Tç – 6b

**Figs. 7 –13.** *Leiotriletes dorogensis* KEDVES; **Fig. 7.** Slide no: Tç – 6c;
**Fig. 8.** Slide no: Tç – 6a; **Figs. 9,10,12,13.** Slide no: Tç – 6b; **Fig. 11.** Slide no: Hka – 8c;

**PLATE I**



## PLATE II

**Figs. 1 –4.** *Retitriletes fragilis* SCHULER & SITTLER;**Fig. 1.** Slide no: Tç – 2f; **Figs. 2,4.** Slide no: Tç – 2a; **Fig. 3.** Slide no: Tç – 2y;

**Figs. 5 –7.** *Trilites multivallatus* (PF. *in* TH. & PF.) KRUTZSCH; **Fig. 5.** Slide no: Tç – 2a; **Fig. 6.** Slide no: Tç – 2f; **Fig. 7.**Slide no: Tç – 2c

**Fig. 8.** *Trilites embriyonalis* KRUTZSCH; Slide no: Tç – 2e

**Figs. 9 –10.** *Polypodiaceoisporites lusaticus* KRUTZSCH; **Fig. 9.** Slide no: Tç – 2m; **Fig. 10.** Slide no: Tç – 2a

**Figs. 11 –15.***Baculatisporites primarius* (WOLLF) *crassiprimarius* KRUTZSCH; **Fig. 11,13.** Slide no: Tç – 3c; **Fig. 12.** Slide no: Tç – 3a; **Fig. 14.** Slide no: Tç – 3b; **Fig. 15.** Slide no: Tç – 3d;

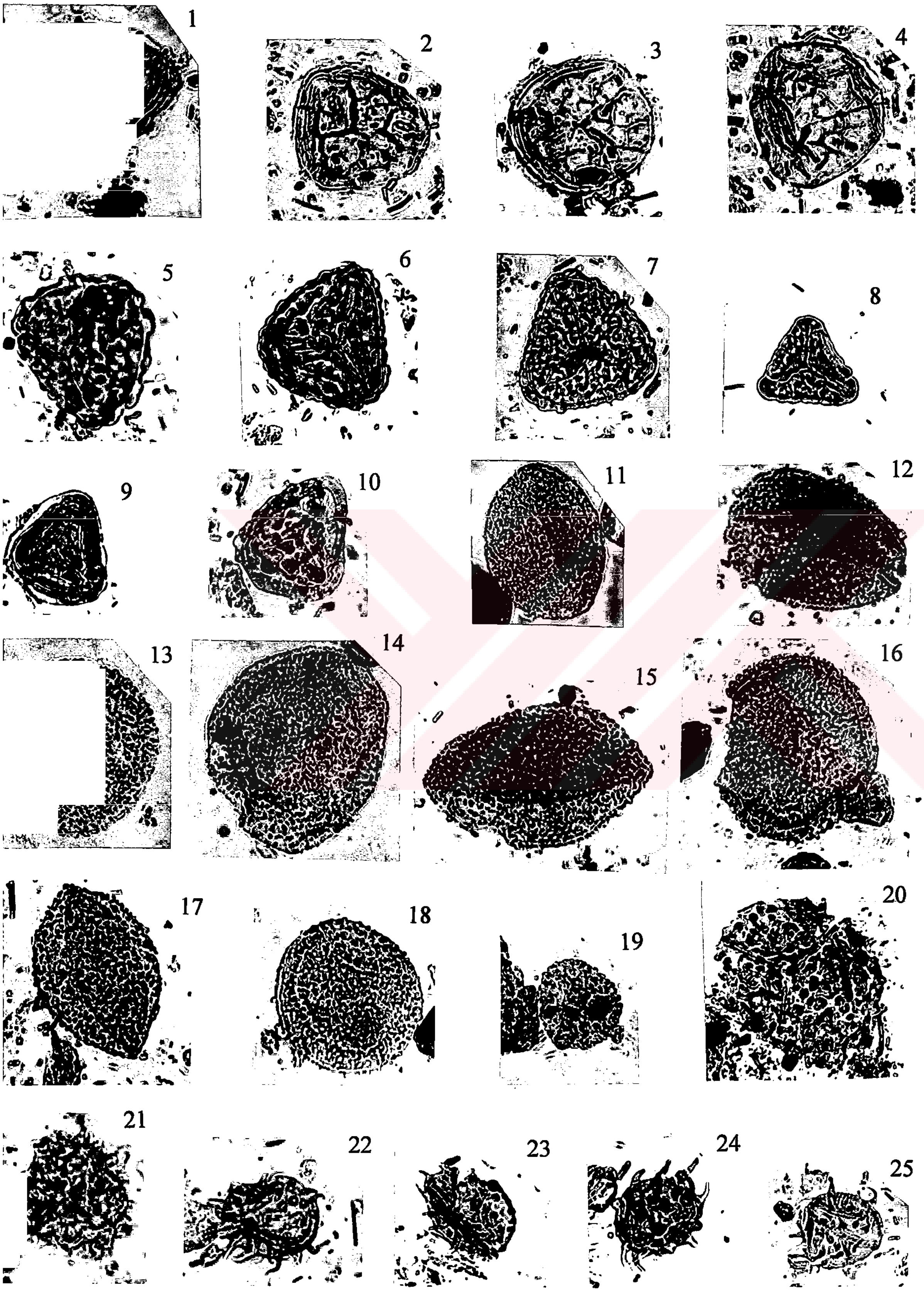
**Figs. 16 –18.***Baculatisporites primarius* (WOLLF) *oligocaenicus* KRUTZSCH; **Fig. 16.** Slide no: Tç – 2c; **Fig. 17.** Slide no: Tç – 2a **Fig. 18.** Slide no: Tç – 3a

**Fig. 19.** *Baculatisporites nanus* (WOLLF) KRUTZSCH; Slide no: Tç – 3a

**Figs. 20 –21.***Echinatisporis* cf. *bockwitzensis* KRUTZSCH; **Fig. 20.** Slide no: Tç – 2c; **Fig. 21.** Slide no: Tokça – 6a

**Figs. 22 –25.***Echinatisporis longechinus* KRUTZSCH;**Figs. 22,25.** Slide no: Tç – 2a **Fig. 23.** Slide no: Tç – 2f; **Fig. 24.** Slide no: Tç – 2d;

PLATE II



## PLATE III

**Figs. 1 –3.** *Lusatisporis perinatus* KRUTZSCH; **Fig. 1.** Slide no: Tç – 2a;
**Figs.2,3.** Slide no: Tç – 2c

**Fig. 4.** *Laevigatosporites haardti* (R. POT. & VEN.) TH. & PF.
*haartioides* KRUTZSCH; Slide no: Tç – 3a.

**Figs. 5 –8** *Laevigatosporites haardti* (R. POT. & VEN.) TH. & PF.;
**Fig. 5.** Slide no: Tç$_3$ – $99_{(4)}$; **Figs. 6.**Slide no: Tç – 2f;
**Fig. 7.** Slide no: Tç – 6a;**Fig. 8.** Slide no: Tç – 2a

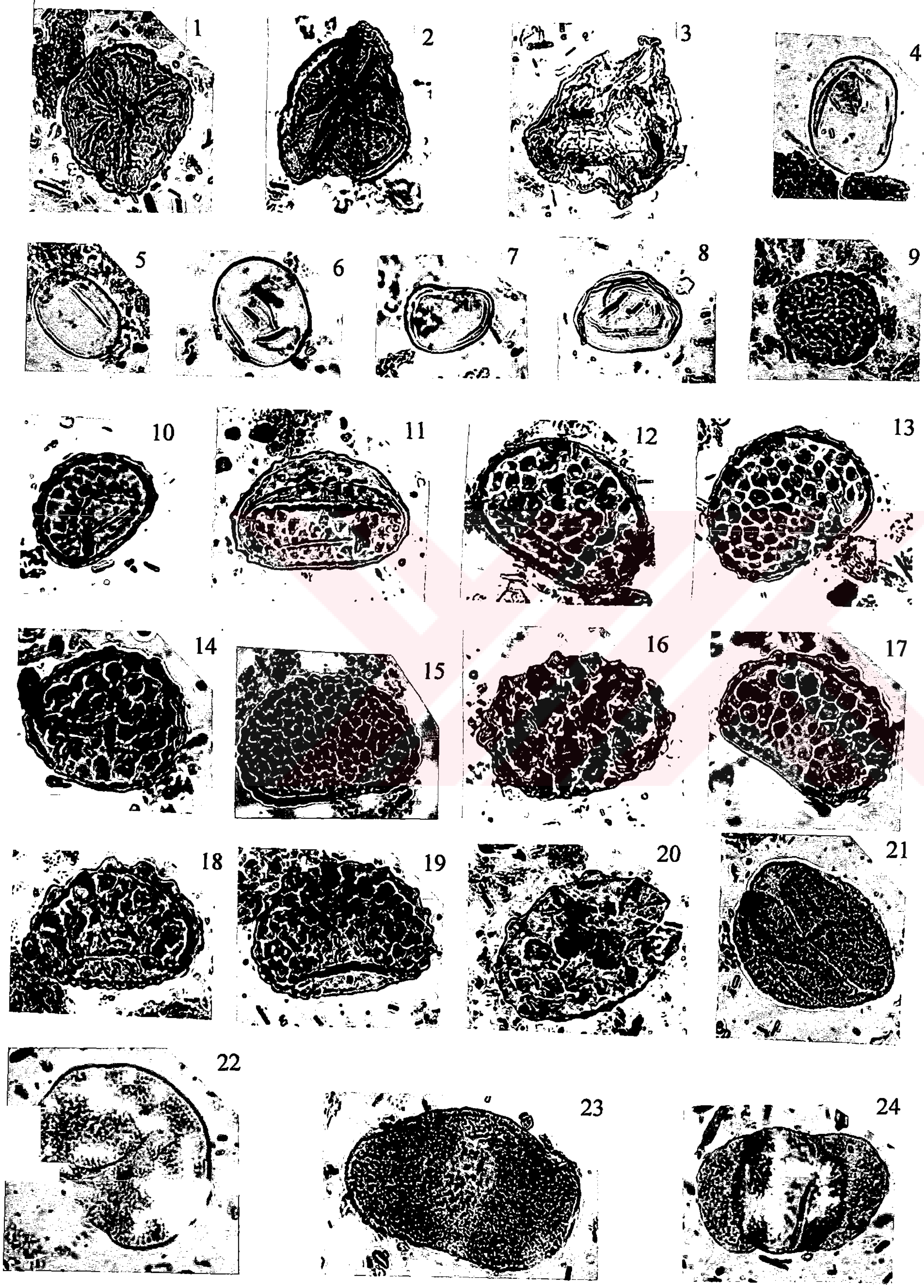
**Figs. 9 –15.** *Verrucatosporites favus* (R. POT.) TH. & PF.;
**Figs. 9,14.** Slide no: Tç$_3$ – $99_{(e)}$; **Fig. 10.** Slide no: Tç – 2d;
**Fig. 11.** Slide no: Tç$_3$ – a; **Fig. 12.** Slide no: Tç – 2y;
**Fig. 13.** Slide no: Tç – 2x; **Fig. 15.** Slide no: Tç$_3$ – $99_{(c)}$

**Figs. 16 –19.** *Verrucatosporites alienus* (R. POT.) TH. & PF.;
**Fig. 16.** Slide no: Tç$_3$ – $99_{(2)}$; **Fig. 17.** Slide no: Tç – 2e;
**Fig. 18.** Slide no: Tç$_3$ – $99_{(c)}$; **Fig. 19.** Slide no: Tç$_3$ – $99_{(d)}$

**Fig. 20.** *Verrucatosporites scutulum* NAKOMAN; Slide no: Tç$_3$ – $99_{(1)}$

**Figs. 21 –24.** *Pityosporites microalatus* (R. POT.) TH. & PF.;
**Fig. 21.** Slide no: Tç – 2g; **Figs. 22,24.** Slide no: Tç – 2a;
**Fig. 23.** Slide no: Tç – 2f

**PLATE III**



## PLATE IV

**Fig. 1.** *Pityosporites microalatus* (R. POT.) TH. & PF.; Slide no: $Tç_3 - 99_{(7)}$

**Figs 2 –3.** *Pityosporites labdacus* (R. POT.) TH. & PF.; **Fig. 2.** Slide no: Tç – 2h; **Fig. 3.** Slide no : $Tç_3 - 99_{(c)}$

**Fig. 4.** *Pityosporites absolutus* (THEIERG.) TH. & PF.; Slide no: $Tç_3 - 99_{(7)}$

**Fig. 5.** *Pityosporites strobipites* (WODEHOUSE) KRUTZSCH;Slide no: Tç – 2f

**Figs. 6 –8.** *Podocarpidites libellus* (R. POT.) KRUTZSCH; **Fig. 6.** Slide no: Tç – 6b;**Fig. 7.** Slide no: $Tç_3 - 99_{(g)}$; **Fig. 8.** Slide no: Tç – 2a

**Figs. 9 –10.** *Inaperturopollenites magnus* (R. POT.) PF.& TH *in* TH. & PF.; **Figs. 9,10.** Slide no: $Tç_3 - 99_{(c)}$;

**Figs. 11 –14.** *Inaperturopollenites dubius* (R. POT. & VEN.) PF.& TH *in* TH. & PF.; **Figs. 11,14.** Slide no: $Tç_3 - 99_{(d)}$; **Fig. 12.** Slide no: Tç – 2f; **Fig. 13.** Slide no: Tç – 2c

**Figs. 15 –18.***Inaperturopollenites hiatus* (R. POT.) PF.& TH *in* TH. & PF.; **Fig. 15.**Slide no: Tç – 2g; **Fig. 16,17,18.** Slide no: Tç – 2a;

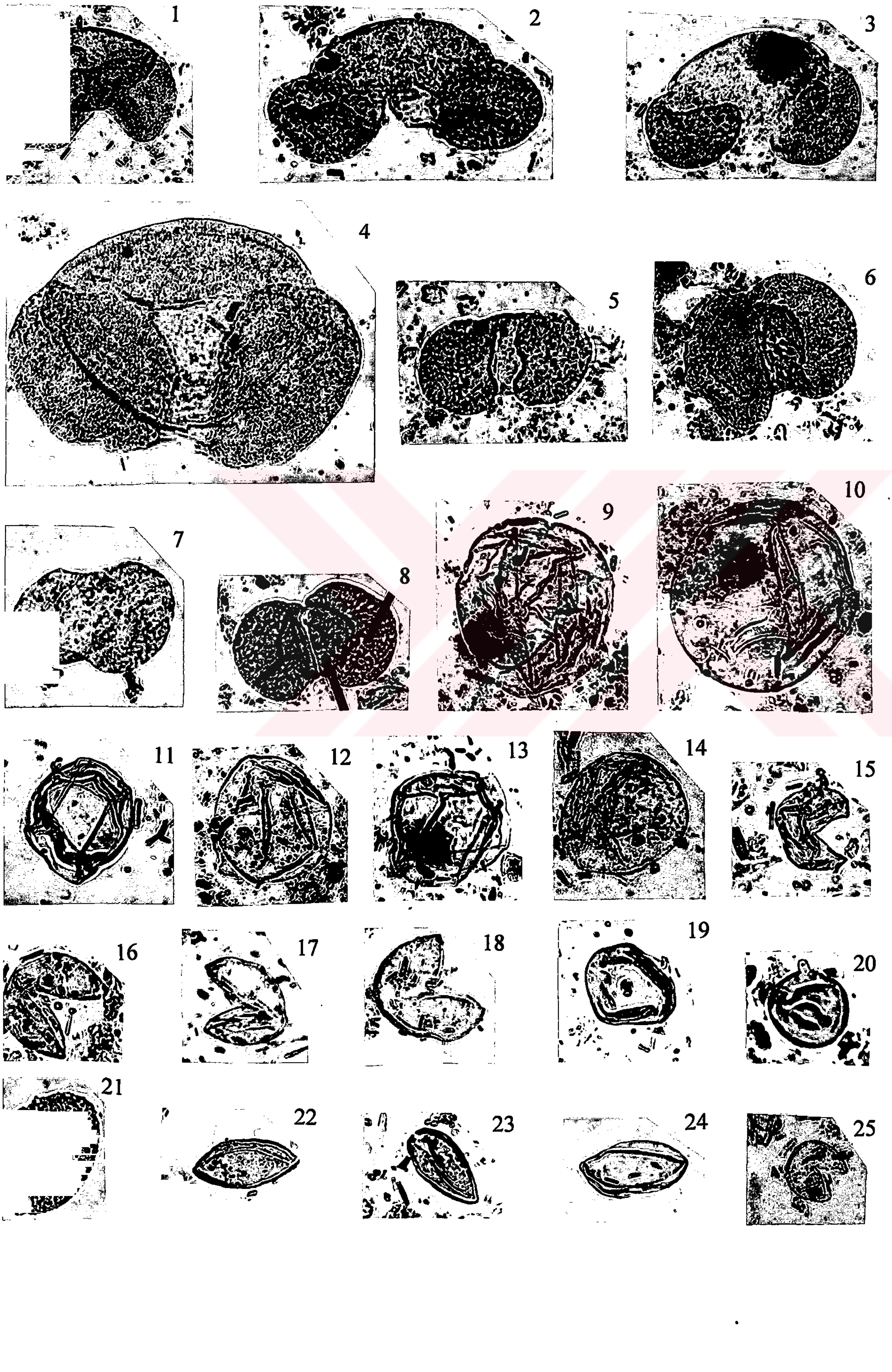
**Figs. 19 –20.** *Inaperturopollenitess polyformosus* (THEIERG.) TH. & PF.; **Fig. 19.**Slide no: Tç – 2f ;**Fig. 20.** Slide no: Tç – 2a

**Fig. 21.** *Sciadopityspollenites serratus* (R. POT.) THEIERG.; Slide no: $Tç_3 - 99_{(b)}$

**Figs. 22 –24.***Cycadopites gracilis* (WODEHOUSE) KRUTZSCH; **Fig. 22.** Slide no: Tç – 2a;**Fig. 23.** Slide no: Tç – 2b; **Fig. 24.** Slide no: Tç – 2d

**Fig. 25.** *Monogemmites pseudosetarius* (WEYLAND &PFLUG) KRUTZSCH;Slide no: Tç – 2c

**PLATE IV**



## PLATE V

**Figs.1 –3.** *Monogemmites pseudosetarius* (WEYLAND & PFLUG) KRUTZSCH; **Fig. 1.** Slide no: Tç – 2c; **Fig. 2.** Slide no: Tç – 2g; **Fig. 3.** Slide no: Tç – 2a

**Figs. 4 –5.** *Spinozonocolpites echinatus* MULLER; **Fig.4.** Slide no: HK – 5b; **Fig. 5.** Slide no: HK-5c

**Fig. 6 a,b.** *Spinozonocolpites* sp.; Slide no: HK – 2e

**Figs. 7 –10.** *Longapertites* sp.; **Fig. 7.** Slide no: $Tç_3 – 99_{(d)}$; **Fig. 8.** Slide no: $Tç_3 – 99_{(2)}$; **Figs. 9,10.** Slide no: $Tç_3 – 99_{(c)}$

**Figs. 11 –13.** *Monoporopollenites gramineoides* MEYER; **Fig. 11,13.** Slide no: $Tç_3 – 99_{(d)}$; **Fig. 12.** Slide no: $Tç_3 – 99_{(f)}$

**Figs. 14 –16.** *Sparganiaceaepollenites polygonalis* THEIERG.; **Fig. 14.** Slide no: $Tç_3 – 99_{(e)}$; **Fig. 15.** Slide no: Tç – 6b; **Fig. 16.** Slide no: Tç – 2f

**Figs. 17 –20.** *Sparganiaceaepollenites neogenicus* KRUTZSCH; **Fig. 17.** Slide no: $Tç_3 – 99_{(a)}$; **Fig. 18.** Slide no: $Tç_3 – 99_{(d)}$; **Fig. 19.** Slide no: $Tç_3 – 99_{(e)}$; **Fig. 20.** Slide no: $Tç_3 – 99_{(f)}$

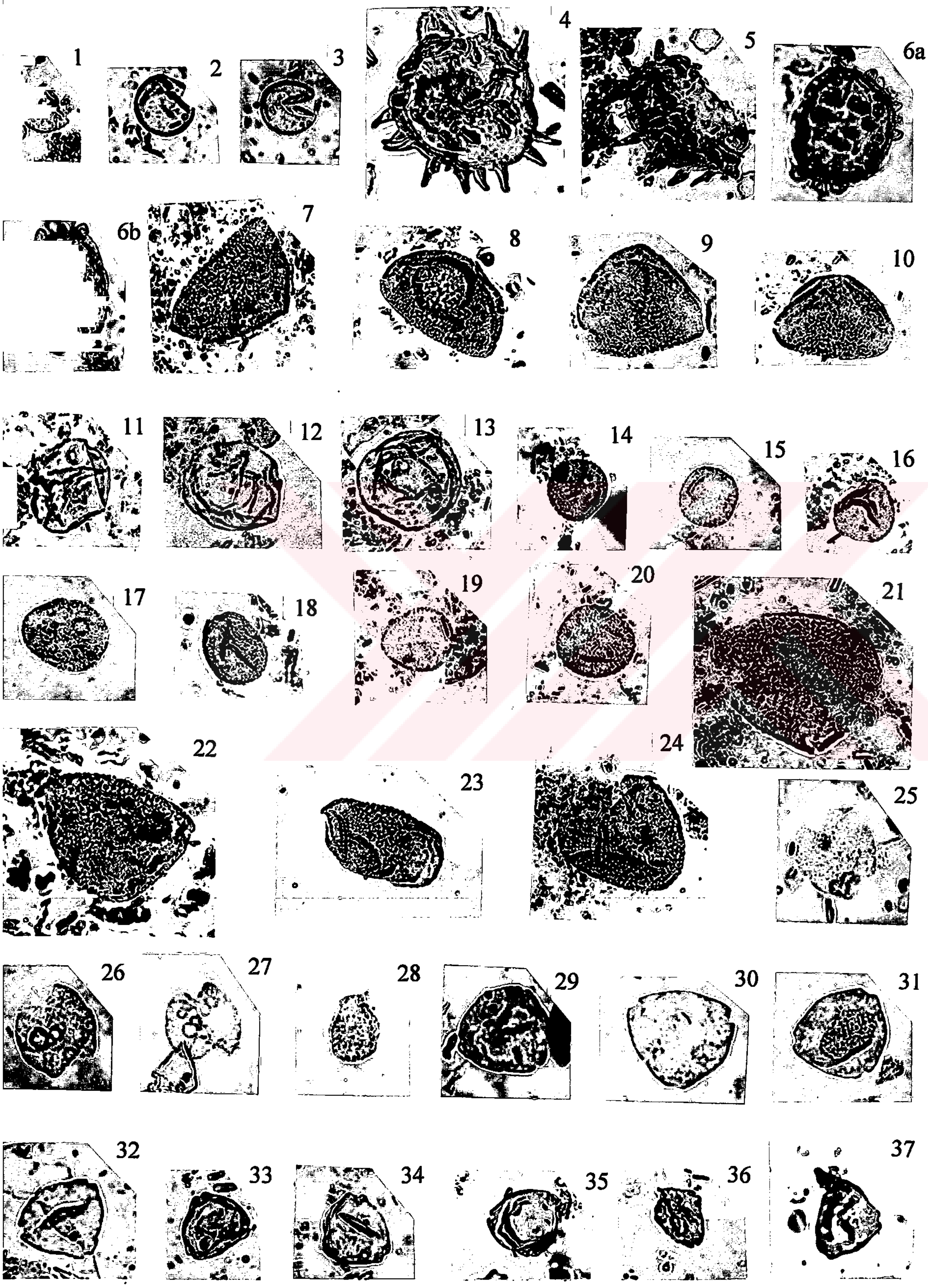
**Figs. 21 –24.** *Aglaoeridia cyclops* ERDTMAN; **Fig. 21.** Slide no: Tç – 2f; **Figs. 22 –24.** Slide no: $Tç_3 – 99_{(a)}$

**Figs. 25 –28.** *Dicolpopollis kockelii* PFLANZ; **Fig. 25,27.** Slide no: Tç – α; **Fig. 26.** Slide no: Tç – c; **Fig. 28.** Slide no: Tç – a

**Figs. 29 –32.** *Triatriopollenites pseudorurensis* PF. & TH. *in* TH. &PF.; **Figs. 29,30.** Slide no: Tç – a; **Fig. 31.** Slide no: Tç – b; **Fig. 32.** Slide no: Tç – c

**Figs. 33 –37.** *Triatriopollenites rurensis* PF. & TH. *in* TH. &PF.; **Fig.33.** Slide no: Tç – 2h; **Fig. 34.** Slide no: Tç – 2(5); **Fig. 35.** Slide no: Tç – c; **Fig. 36.** Slide no: Tç – 2b; **Fig. 37.** Slide no: Tç – 2f

PLATE V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## PLATE VI

**Figs. 1 – 4.** *Triatriopollenites bituitus* (R. POT.) TH. & PF.;

**Fig. 1.** Slide no: $Tç_3 - 99_{(g)}$; **Fig. 2.** Slide no: $Tç_3 - 99_{(e)}$

**Fig. 3.** Slide no: Tç – 2a; **Fig.4.** Slide no: Tç – 2(6)

**Figs. 5 –10.** *Triatriopollenites coryphaeus* (R.POT.) TH. & PF.;

**Figs. 5,7.** Slide no: Tç –2a; **Fig. 6.** Slide no: Tç – 2d;

**Fig. 8.** Slide no: Tç – 2f;**Fig. 9.** Slide no: Tç – 2b;

**Fig. 10.** Slide no: $Tç_3 - 99_{(4)}$

**Figs. 11 –15.***Momipites punctatus* (R. POT.) NAGY; **Fig. 11.** Slide no: Tç – 2f;

**Fig. 12.** Slide no: Tç – 2h; **Fig. 13.** Slide no: $Tç_3 - 99_{(c)}$ ; **Fig. 14.** Slide no: Tç – 2g; **Fig. 15.** Slide no: Tç – 2d

**Figs. 16 –17.***Momipites quietus* (R. POT.) NICHOLS; **Figs. 16,17.** Slide no: Tç – 2f;

**Figs. 18 –22.***Momipites* sp.; **Fig. 18a,b.** Slide no: $Tç_3 - 99_{(e)}$;

**Fig. 19.** Slide no: $Tç_3 - 99_{(f)}$; **Fig. 20.** Slide no: $Tç_3 - 99_{(g)}$; **Fig. 21.** Slide no: $Tç_3 - 99_{(7)}$; **Fig. 22.** Slide no: $Tç_3 - 99_{(9)}$

**Figs. 23 –24.***Corsinipollenites oculis* ssp.*noctis* (THEIERG.)NAKOMAN;

**Fig. 23.**Slide no: Tç – 2 (1); **Fig. 24.**Slide no: $Tç_3 - 99_{(c)}$

**Fig. 25.** *Triporopollenites robustus* (MÜRRIG. & PF.) PF. *in* TH. & PF.;

Slide no: Tç –2c

**Fig. 26.** *Triporopollenites megagranifer* (R. POT.) TH. & PF.; Slide no: Tç – 2a

**Figs. 27 –32.***Olaxipollis matthesii* KRUTZSCH;**Fig. 27.** Slide no: Tç – 2e;

**Fig. 28.** Slide no: Tç – 2x; **Fig. 29.** Slide no: Tç – 7b;

**Figs. 30,31.** Slide no:Tç – 2a; **Fig. 31.** Slide no: Tç – 7c;

**Figs. 33 –36.***Trivestibulopollenites betuloides* PF. *in* TH. & PF.;

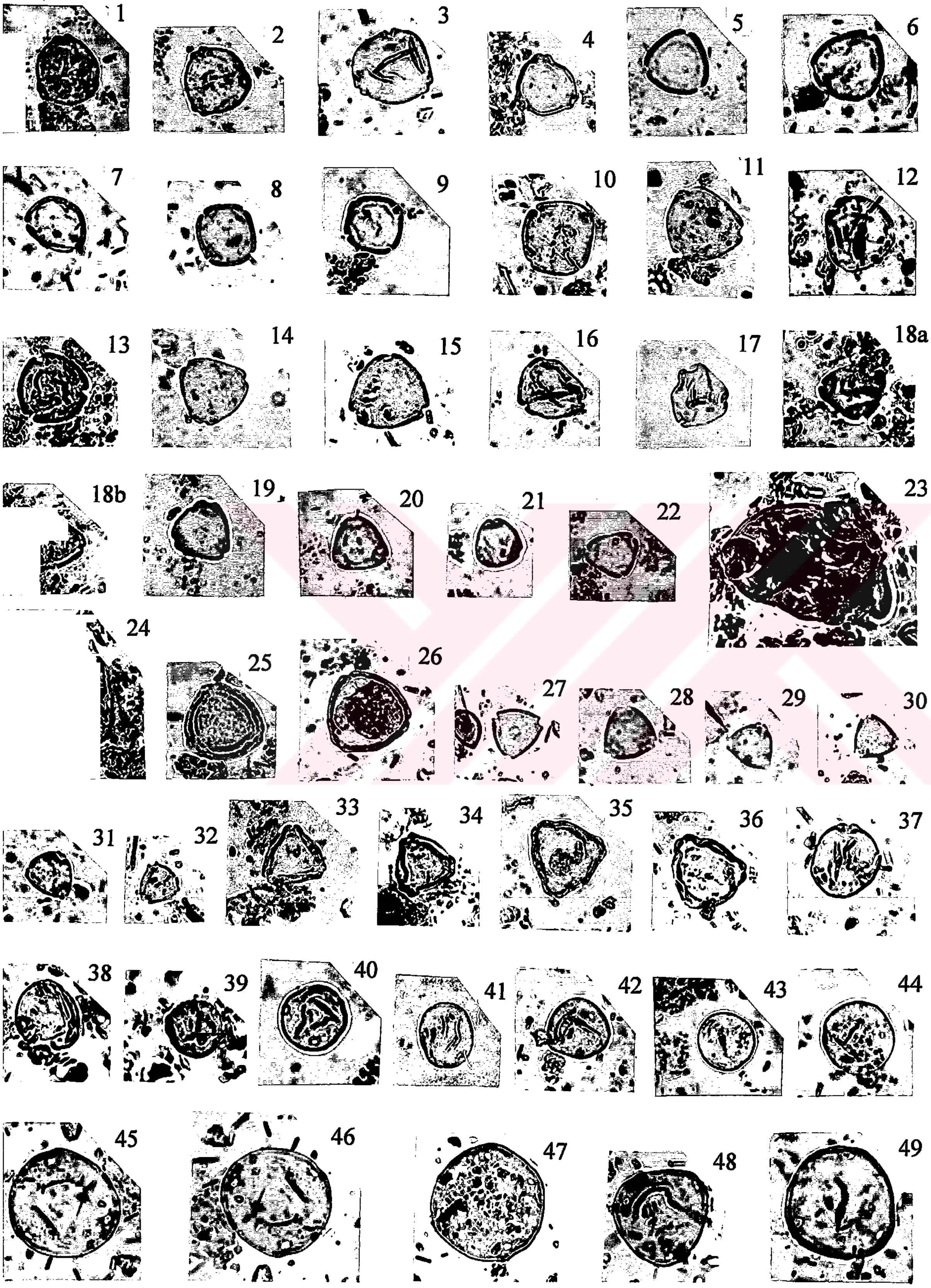
**Fig. 33.** Slide no: $Tç_3 - 99_{(d)}$; **Fig. 34.** Slide no: $Tç_3 - 99_{(e)}$; **Fig. 35.** Slide no: Tç – 2 ( 4 ); **Fig. 36.** Slide no Tç – 2a

**Figs. 37 –38.***Trivestibulopollenites prominens* PF. *in* TH. & PF.;

**Fig. 37.** Slide no:Tç – 2a; **Fig. 38.**Slide no: Tç – 2e

**Figs. 39 –44.***Subtriporopollenites anulatus* PF. & TH.*in* TH. & PF. ssp. *nanus* PF & TH. in TH. & PF.; **Fig. 39.** Slide no: Tç – 2f; **Fig. 40.**

## PLATE VI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Slide no: Tç$_3$ – 99$_{(a)}$; **Fig. 41.** Slide no: Tç – 6e; **Fig. 42.**

Slide no: Tç – 2c; **Fig. 43.** Slide no: Tç – 2m; **Fig. 44.** Slide no: Tç$_3$ – 99$_{(7)}$

**Figs. 45 –49.** *Subtriporopollenites simplex* (R. POT.& VEN.)

TH. & PF. ssp. *simplex* (R. POT. & VEN.) TH. & PF.;

**Fig. 45.** Slide no: Tç – 2c; **Figs. 46,49.** Slide no: Tç – 2a;

**Fig. 47.** Slide no: Tç – 2x; **Fig.48.** Slide no: Tç – 2k**Fig. 49.**Slide no: Tç – 2a

## PLATE VII

**Figs. 1 –3.** *Subtriporopollenites* cf.*latiporotus* CHATEAUNEUF;
**Fig. 1.** Slide no: Tç – 2e; **Fig. 2.** Slide no: $Tç_3$ – $99_{(d)}$;
**Fig. 3.** Slide no: Tç – 2a

**Figs. 4 –6.** *Subtriporopollenites constans* PF. *in* TH. & PF.;
**Fig. 4.** Slide no: $Tç_3$ – $99_{(b)}$; **Figs. 5,6.** Slide no: $Tç_3$ – $99_{(d)}$;

**Figs. 7 –8.** *Compositoipollenites rhizophorus* (R. POT.)R. POT. ssp.*burghasungensis* (MÜRRIG. & PF.) MÜRRIG. & PF. *in* TH. & PF. ;**Fig. 7.** Slide no: Tç – 2f; **Fig. 8.** Slide no: Tç – 2a

**Figs. 9 –12.** *Intratriporopollenites indubitalibis* (R. POT.) PF. & TH. *in*TH. &PF. ; **Figs. 9,10.** Slide no: Tç – 2h; **Fig. 11.** Slide no: Tç – 2e; **Fig. 12.** Slide no: Tç – 2a

**Figs. 13 –17.***Intratriporopollenites instructus* (R. POT.) TH. & PF.;
**Fig. 13.** Slide no: Tç – 2h; **Figs. 14,15.** Slide no: Tç – 2c;
**Fig. 16.** Slide no: HK – 5c;**Fig. 17.** Slide no: HK – 5d

**Figs. 18 –21.***Polyporopollenites undulosus* (WOLFF) TH. & PF.; **Fig. 18.** Slide no: $Tç_3$ – $99_{(b)}$; **Figs. 19,20,21.** Slide no: Tç – 2a

**Figs. 22 –24.***Polyporopollenites carpinoides* PF. *in* TH. & PF.; **Fig. 22.** Slide no: Tç – 2x; **Fig. 23.** Slide no: Tç – 2e; **Fig. 24.** Slide no: Tç – 2a

**Figs. 25 –26.***Polyporopollenites stellatus* (R. POT. & VEN.) TH. & PF.;
**Fig 25.** Slide no: Tç – 2g;**Fig. 26.** Slide no: Tç – 2a

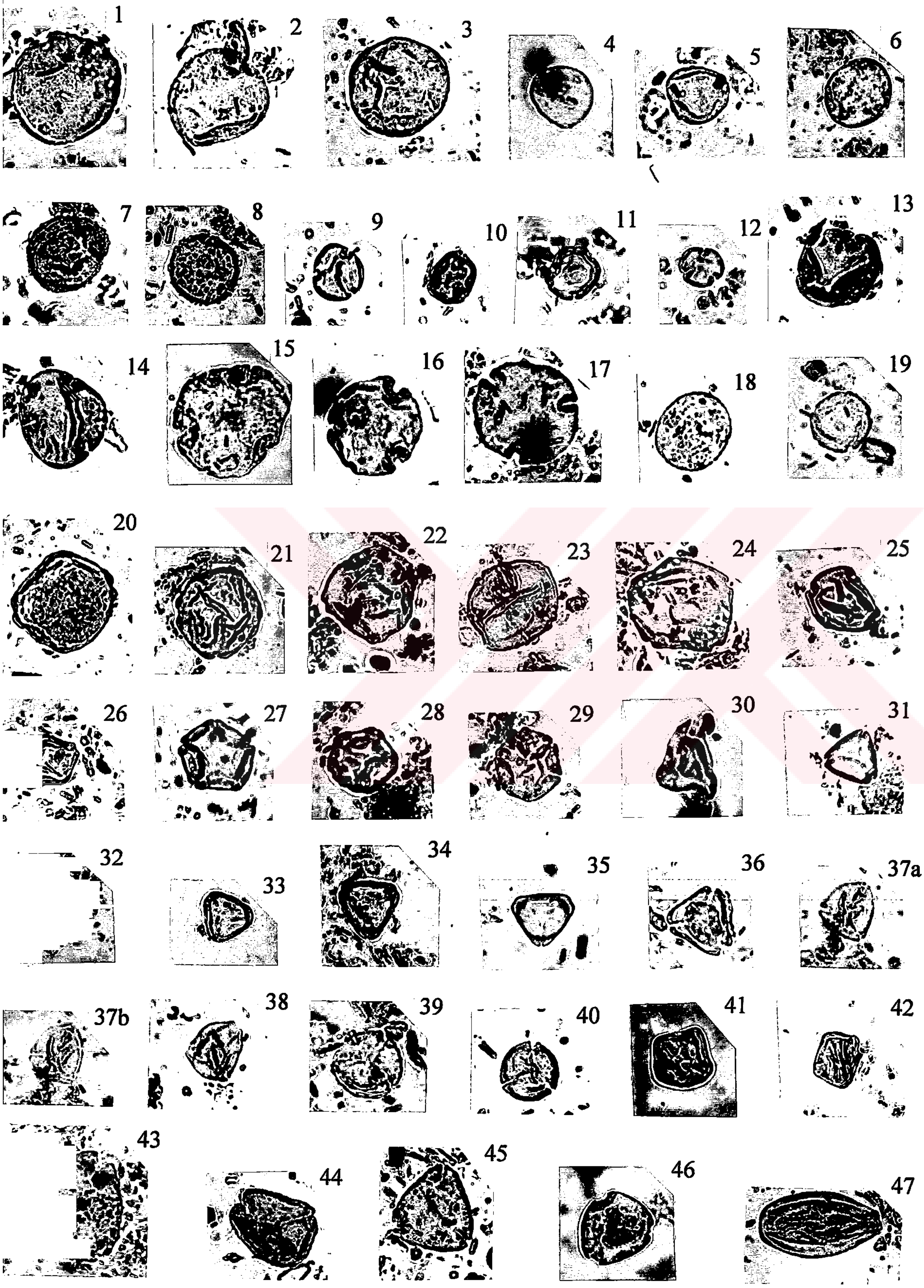
**Figs. 27 –29.***Polyvestibulopollenites verus* (R. POT.) TH. & PF.; **Fig.27.** Slide no: Tç – 2c; **Fig. 28.** Slide no: $Tç_3$ – $99_{(c)}$;**Fig. 29.** Slide no: Tç – 2e

**Fig. 30.** *Boehlensipollis hohli* KRUTZSCH; Slide no: HK – 5a

**Figs. 31 –36.***Myrtaceidites mesonesus* COOKSON & PIKE; **Figs. 31,32,34.** Slide no: $Tç_3$ – $99_{(f)}$; **Fig. 33.** Slide no: $Tç_3$ – $99_{(b)}$;
**Fig. 35.** Slide no: Tç – γ; **Fig. 36.** Slide no: $Tç_3$ – $99_{(5)}$

**Fig. 37 –38.** *Slowakipollis hipophäeoides* KRUTZSCH;
**Fig 37a,b.** Slide no: Tokça – 6a; **Fig.38.** Slide no: Tç – 2x

**PLATE VII**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**Figs. 39 –40.** *Cupaniëidites eucalyptoides* KRUTZSCH; **Fig.39.** Slide no: Tç – 2(5);
**Fig. 40.** Slide no: Tç – 2z

**Figs. 41 –42.** *Pentapollenites pentangulus* (PF. *in* TH. & PF.) KRUTZSCH;
**Fig. 41.** Slide no: Tç – 6d; **Fig. 42.** Slide no: Tç – 6f

**Figs. 43 –46.** *Porocolpopollenites vestibulum* (R. POT.) TH. & PF.; **Fig.43.** Slide no: Tç – 2(6); **Fig. 44.** Slide no: Tç – 2f; **Fig. 45.** Slide no: Tç – 2a; **Fig. 46.** Slide no: Tç – 2x

**Fig. 47.** *Tricolpopollenites henrici* (R. POT.) TH. & PF.; Slide no: Tç – 2a

## PLATE VIII

**Fig. 1.** *Tricolpopollenites henrici* (R. POT.) TH. & PF.; Slide no: Tç – 2c

**Figs 2 –3.** *Tricolpopollenites densus* PF. *in* TH. & PF.; **Fig.2.** Slide no: Tç – 2a; **Fig. 3.** Slide no: Tç – 2h

**Figs 4 –6.** *Tricolpopollenites retiformis* PF. & TH. *in* TH. & PF.; **Fig. 4.** Slide no: Tç – 6b; **Fig. 5.** Slide no: Tç – 2b; **Fig. 6.** Slide no: Tç – 2f

**Figs. 7 –11.** *Tricolpopollenites microhenrici* (R. POT.) TH. & PF.;**Fig. 7.** Slide no: Tç - 2f; **Fig. 8.** Slide no: Tç – 2g; **Fig. 9.** Slide no: Tç$_3$ – a **Fig. 10.** Slide no: Tç – 2x; **Fig. 11.** Slide no: Tç – 2z

**Figs. 12 –13.** *Tricolpopollenites liblarensis* (TH.) TH. & PF. ssp.*fallax* (R. POT.) TH. & PF.; **Fig.12.** Slide no: Tç – 6b; **Fig.13.**Slide no: Tç – 2a

**Figs. 14 –17.** *Tricolpopollenites akgünii* n.sp., **Fig. 14.** Slide no: Tç$_3$ – 99$_{(c)}$; **Fig. 15.** Slide no: Tç$_3$ – 99$_{(b)}$; **Fig. 16.** Slide no: Tç – 6c; **Fig. 17.** Slide no: Tç$_3$ – 99$_{(a)}$

**Fig. 18.** *Aceripollenites* cf. *reticulatus* NAGY; Slide no: Tç – 2f

**Figs. 19 –21.***Polycolpites specious* DUTTA & SAH; **Fig. 19.** Slide no: Tç$_3$ – 9$_{(c)}$; **Fig. 20.** Slide no: Tç$_3$ – 99$_{(2)}$; **Fig. 21.** Slide no: Tç$_3$ – 99$_{(4)}$

**Figs. 22 –23.***Polycolpites* sp.; **Fig.22.** Slide no: Tç –6d; **Fig. 23.** Slide no: Tç – 7b

**Figs. 24 –25.***Tricolporopollenites villensis* (TH.) TH. & PF.; **Fig.24.** Slide no: Tç – 2b; **Fig. 25.** Slide no: Tç – 2d

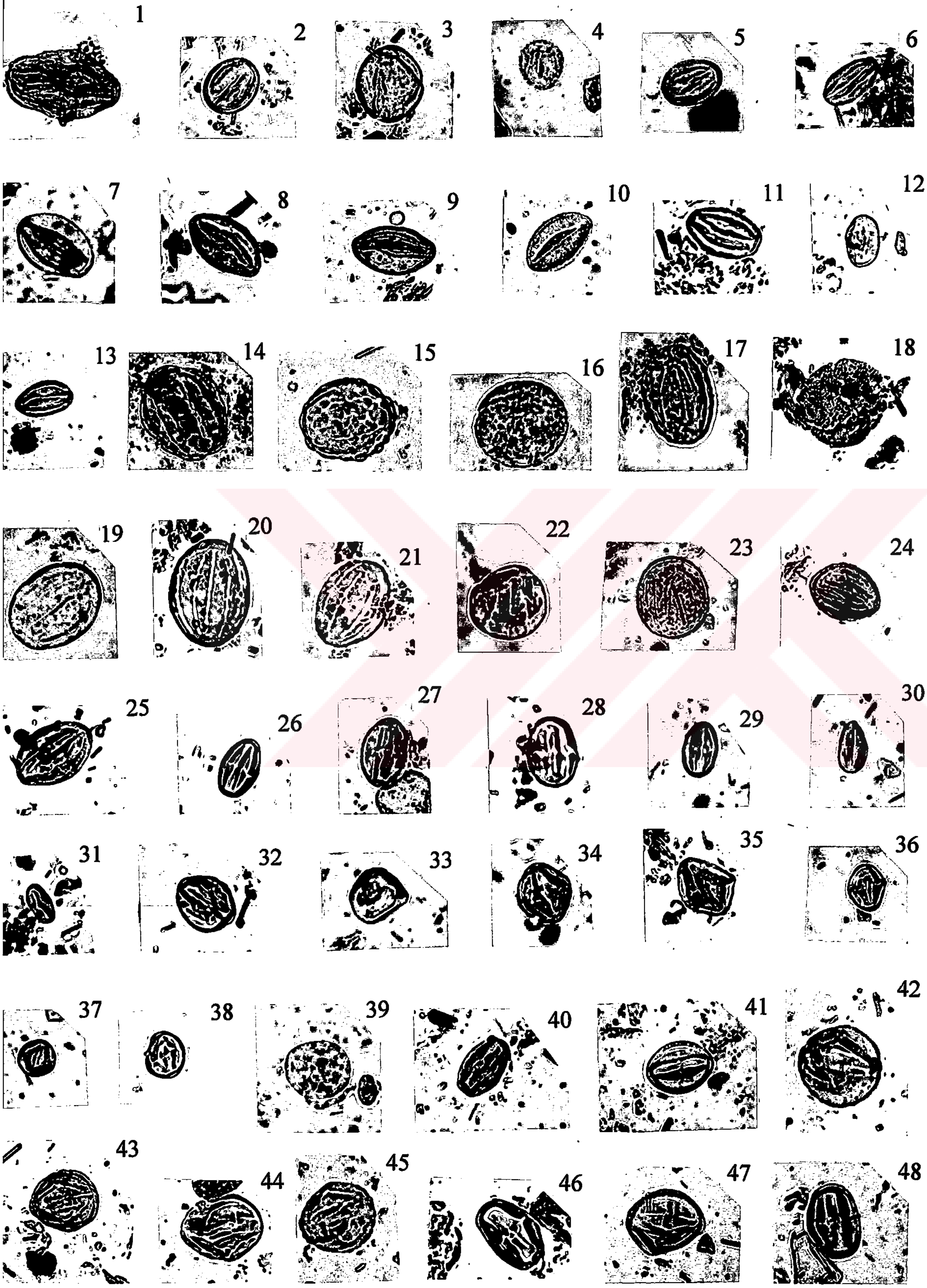
**Figs. 26 – 28.***Tricolporopollenites cingulum* (R. POT.) TH. & PF. ssp. *fusus* (R. POT.) TH. & PF.; **Fig.26,27.** Slide no: Tç – 2h; **Fig. 28.**Slide no: Tç – 2c

**Figs. 29 –30.** *Tricolporopollenites cingulum* (R. POT.) TH. & PF. ssp. *pusillus* (R. POT.) TH. & PF.; **Fig. 29,30.** Slide no: Tç – 2a;

**Fig. 31.** *Tricolporopollenites cingulum* (R. POT.) TH. & PF. ssp. *oviformis* (R. POT.) TH. & PF.; Slide no: Tç – 2f

**Figs. 32 –35.***Tricolporopollenites megaexactus* (R. POT.) TH. & PF. ssp. *brühlensis* (TH.) TH. & PF.; **Fig.32, 33, 34,35.** Slide no: Tç – 2f

**PLATE VIII**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**Figs. 36 –38.** *Tricolporopollenites megaexactus* (R. POT.) TH. & PF. ssp. *exactus* (R. POT.) TH. & PF.; **Fig. 36, 38.** Slide no: Tç – 2f;
**Fig. 37.** Slide no: Tç – 2a

**Figs. 39 –41.** *Tricolporopollenites steinensis* PF. *in* TH. & PF.; **Fig.39.** Slide no: Tç – 7c; **Fig. 40.** Slide no: Tç – 2y; **Fig. 41.** Slide no: Tç – 2a

**Figs. 42 –45.** *Tricolporopollenites pseudocingulum* (R. POT.) TH. & PF.;
**Fig.42.** Slide no: Tç – 2a; **Fig.43,45.** Slide no: Tç – 2f;
**Fig. 44.** Slide no: Tç – 1a

**Figs. 46 –48.** *Tricolporopollenites pacatus* PF. *in* TH. & PF.; **Fig.46.** Slide no: Tç – 2y;
**Fig. 47.** Slide no: Tç – 2g; **Fig. 48.** Slide no: Tç – 2m

## PLATE IX

**Figs. 1 –2.** *Tricolporopollenites euphorii* (R. POT.) TH. & PF.; **Fig.1.** Slide no: Tç – 2a; **Fig. 2.** Slide no: $Tç_3 – 99_{(c)}$

**Figs. 3 –4.** *Tricolporopollenites eschweilerensis* PF. & TH. *in* TH. &PF.; **Figs3,4.**Slide no: Tç – 6b

**Figs. 5 –7.** *Tricolporopollenites helmstedtensis* PF. & TH.*in* TH. & PF.; **Fig.5.** Slide no: Tç – 2y; **Figs.6,7.**Slide no: Tç – 2f

**Figs. 8 –11.** *Tricolporopollenites marcodurensis* PF. & TH.*in* TH. & PF.; **Figs 8 –11.** Slide no: Tç – 2a

**Fig. 12.** *Tricolporopollenites kruschi* (R. POT.) TH. & PF. ssp. *analepticus* (R. POT.) TH. & PF.; Slide no: Tç – 1b

**Figs. 13 –14.**Tr*icolporopollenites kruschi* (R. POT.) TH. & PF. ssp. *accesorius* (R. POT.) TH. & PF.;**Fig.13.** Slide no: Tç – 6a; **Fig. 14.** Slide no: Tç – 2m

**Figs. 15 –17.***Tricolporopollenites kruschi* (R. POT.) TH. & PF. ssp. *pseudolaesus*(R. POT.) TH. & PF.; **Fig.15.** Slide no: Tç – d; **Fig. 16.** Slide no: Tç – 2a; **Fig. 17.** Slide no: Tç – 1b

**Figs. 18 –20.***Tricolporopollenites* cf. *kruschi* (R. POT.) TH. & PF.; **Fig.18.** Slide no: $Tç_3 – 99_{(d)}$; **Fig. 19.** Slide no: $Tç_3 – 99_{(1)}$; **Fig. 20.** Slide no: $Tç_3 – 99_{(f)}$

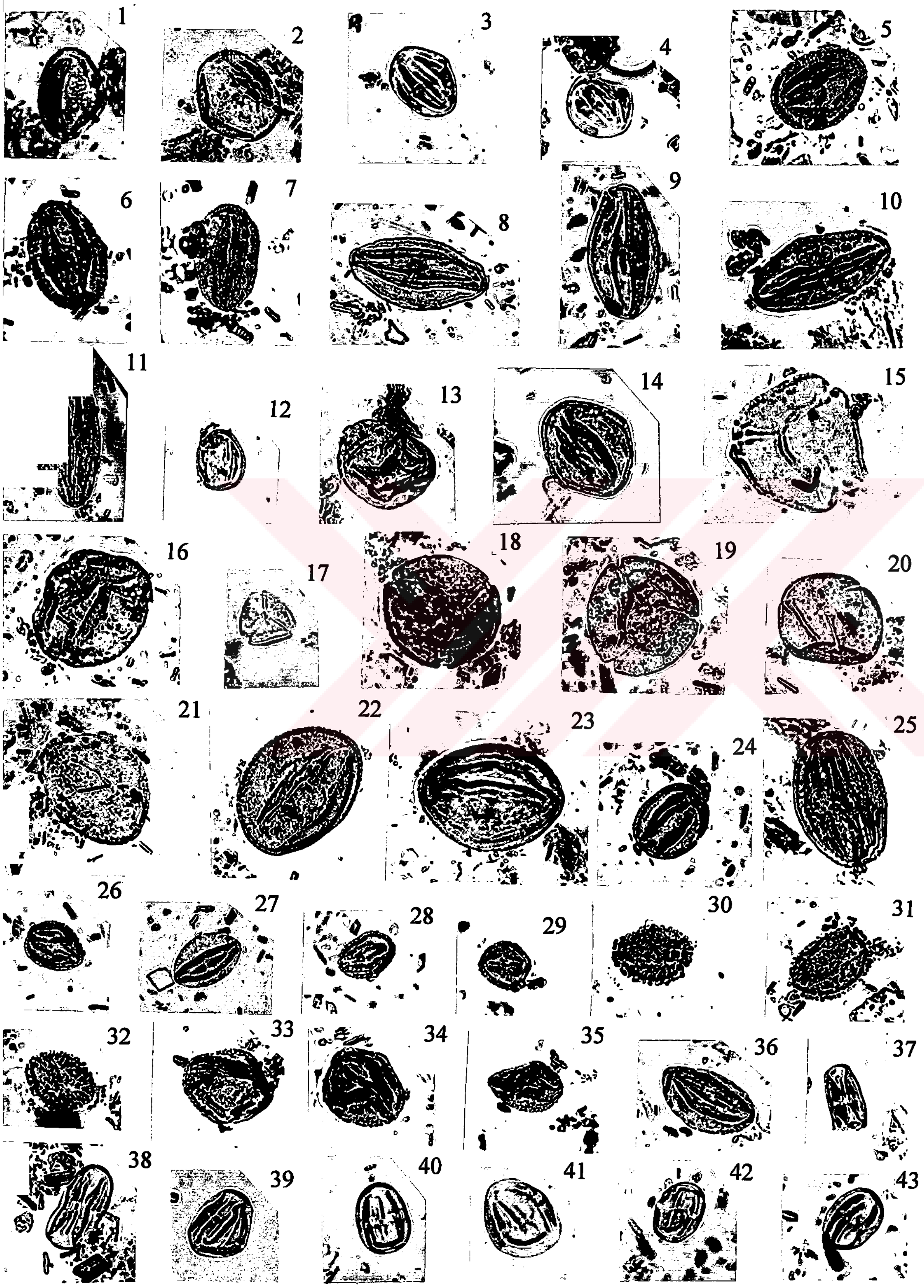
**Figs. 21 –23.***Tricolporopollenites genuinus* (R. POT.) TH. & PF.; **Fig.21.** Slide no: $Tç_3 – 99_{(f)}$; **Fig. 22.** Slide no: $Tç_3 – 99_{(e)}$; **Fig. 23.** Slide no: $Tç_3 – 99_{(c)}$

**Fig. 24.** *Tricolporopollenites* cf. *baculaferus* PF. *in* TH. & PF.; Slide no: Tç – 2g

**Fig. 25.** *Tricolporopollenites porasper* PF. in TH. & PF.; Slide no: Tç – 2f

**Figs. 26 –29.***Tricolporopollenites microreticulatus* PF. & TH. *in* TH. & PF.; **Figs. 26 –29.** Slide no: Tç – 2a

**PLATE IX**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**Figs. 30 –32.** *Tricolporopollenites iliacus* (R. POT.) TH. & PF.;

**Fig.30.** Slide no: Tç – 6e;**Fig. 31.** Slide no: Tç – 2g;

**Fig. 32.** Slide no: $Tç_3 – 99_{(c)}$

**Figs. 33 –35.** *Tricolporopollenites margaritatus* (R. POT. ) TH. & PF. *f. medius* PF. & TH. *in* TH. & PF.; **Fig.33.** Slide no: Tç – 2g;

**Fig. 34.** Slide no: Tç – 2b; **Fig. 35.** Slide no: Tç – 2c

**Fig. 36.** *Tricolporopollenites striatopunctatus* KRUTZSCH & VANHOORNE,; Slide no: Tç – 2a

**Figs. 37 –38.** *Mediocolpopollis compactus* KRUTZSCH, ssp. *ellenhaunensis* KRUTZSCH; **Fig.37.** Slide no: Tç – 2f ;

**Fig. 38.** Slide no: Tç – 2g

**Figs. 39 –41.** *Tetracolporopollenites obscrus* PF. & TH. *in* TH. & PF.;

**Fig.39.** Slide no: Tç – 6c; **Figs.40,41.** Slide no: Tç – 2a

**Figs. 42 –43.** *Tetracolporopollenites abditus* PF. *in* TH. & PF.;

**Figs 42,43.** Slide no: Tç – 2a

## PLATE X

**Fig. 1.** *Tetradopollenites ericius* (R. POT.) TH. & PF.; Slide no: Tç – 2f

**Figs. 2 –3.** *Periporopollenites stigmosus* (R. POT.) TH. & PF.; **Fig.2.** Slide no: $Tç_3$ – $99_{(7)}$; **Fig. 3.** Slide no: $Tç_3$ – $99_{(3)}$

**Figs. 4 –5.** *Periporopollenites* sp.;**Fig. 4.** Slide no: Tç – γ; **Fig. 5.** Slide no: Tç – 2h

**Figs. 6 –8.** *Periporopollenites* sp. (thallictrum type), **Fig. 6.** Slide no: Tç – 2g; **Fig. 7.** Slide no: Tç – 2h; **Fig. 8.** Slide no: Tç – 2d

**Figs. 9 –10.** *Buxapollis buxoides* KRUTZSCH; **Fig.9.** Slide no: Tç – a; **Fig. 10.** Slide no: Tç –2 (8); **Fig. 11.** Slide no: Tç – 1a

**Fig. 12.** *Diporicellaesporites stacyi* ELSIK; Slide no: Tç – 1b

**Figs. 13 –14.** *Anatolinites dongyingensis* (KE & SHI) ELSIK et al.; **Fig.13.** Slide no: Tç – 6a **Fig. 14.** Slide no: Tokça - 3a

**Fig. 15.** *Multicellaesporites* sp. Slide no: Tokça – 6a

**Fig. 16.** *Pluricellaesporites* sp. Slide no: Ar – 2a

**Figs. 17 –18.** *Ovoidites ligneolus* (R. POT.) R. POT.; **Fig.17.** Slide no: Tç – 2g; **Fig. 18.** Slide no: Tç – 2d

**Fig. 19.** *Spiniferites ramosus* (EHRENBERG) LOEBLICH & LOEBLICH; Slide no: $Tç_3$ – $99_{(b)}$

**Fig. 20.** *Cordosphaeridium inodes* (KLUMP) MORG.; Slide no: Ar – 1c

**Figs. 21 –22.** Indetermine form

PLATE X